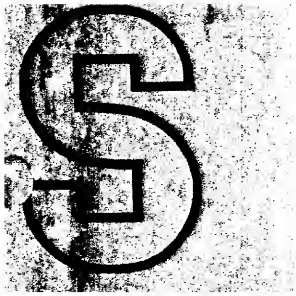

IBM

Reference Manual

SOAP II

for the IBM 650 Data Processing System

MINOR REVISION (July 1957)

This edition, Form 32-7646-1, is a minor revision of the original edition but does not obsolete Form 32-7646. The changes in this edition are:

Page	Subject
32	Three corrections in the 533 wiring diagram
33	Two corrections in the 407 wiring diagram
37	Correction in format of optimizing table entries
52	Correction of subscripts in the flow chart
60	Correction of wording in the flow chart
71	Correction of two lines in listing of optimizing table
72	Correction of one line in listing of optimizing table
86	Correction of one line in listing of constants
92	Correction of three words in the seven-words per card listing
94	Correction of one word in the seven-words per card listing

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PART I: PROGRAMMER'S GUIDE

Introduction

The principal achievement of an assembly program is that it almost completely relieves the programmer of the problem of assigning actual storage locations to instructions or quantities manipulated by the program. If, in the course of programming, he wishes to refer to any location in storage which will contain some quantity used by the program, he gives this location a "name", preferably one of high mnemonic value, and refers to it by means of this name. Thus, salary might be stored in "WAGES", sin x in "SIN X". The assembly program assigns actual locations to these "names" and produces an absolute machine language program.

SOAP II is a symbolic assembly program for the IBM 650 Data Processing System. It is designed to assemble programs written for any array of equipment including tapes, printer, immediate access storage, indexing registers, floating point, disk storage and inquiry stations. The assembly program itself uses none of these features. It will operate on a basic 650 having an alphabetic device. Special features described in the sequel should render it equally useful for both scientific and commercial applications.

Definition of Terms

L = location
D = data (address)
I = instruction (address)
Tag = character used to specify an indexing register
FWA = first word address
LWA = last word address
OP = operation (code)
Block = a consecutive group of drum (or core) locations
Region = a block designated by an alphabetic character
Pseudo-instruction = an instruction which is never executed
Symbolizer part = left-most position of L, OP, D or I field
Absolute part = L, OP, D or I field with symbolizer part deleted
Available = subject to selection as an optimum drum location whenever the assembly program is given freedom of choice
Unavailable = not subject to the above selection
Reserve = to make unavailable
I. A. S. = Immediate Access (core) Storage

SOAP II Coding Form and Input Card Format

Figure 1 shows the coding form to be used when writing for SOAP II. Vertical dotted lines separate the symbolizer and absolute parts of the L, OP, D and I fields. Observe that the input card format is indicated at the top of the form. Punching in columns 1-40 and 73-80 is ignored except for column 2 which must not contain a Y(12) punch.

Instructions and data enter the assembly one word per card. The output is in the form of one word per card load cards.

Specifying Program Area on Drum

Prior to assembly, the entire drum is available to the program. It is invariably necessary, however, to prevent the program from occupying certain drum locations, e.g., input-output blocks, tables, data areas, etc. There are three pseudo operations which can be used to restrict the assembled program to any predesignated parts of the drum:

Block Reservation: BLR

This card contains two absolute drum addresses FWA, LWA (FWA $\leqq$ LWA) punched in the absolute part of the D and I fields, respectively. All locations from FWA to LWA (inclusive) are made unavailable.

For example,

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				BLR	1500		1900		

will make drum locations (1500-1900) unavailable.

Block Availability: BLA

This card is exactly like a BLR card except that it makes all locations from FWA to LWA available. Note that it is generally redundant to put a BLA card at the beginning of an assembly since the entire drum is already available.

By way of illustration,

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				BLA	1600		1730		

650 SOAP II CODING FORM

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72			
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS	ACCUMULATOR		DISTRIBUTOR 8001
										UPPER 8003	LOWER 8002	

PROBLEM_____ CODER_____ DATE_____ PAGE____ OF____

Figure 1

will make drum locations 1600-1730 available.

Regional Specification: REG
This card contains an alphabetic character, punched in the symbolizer part of the D field, to be associated with a block defined by the terminal drum addresses FWA, LWA. As in the case of a BLR card, all locations from FWA to LWA are made unavailable. If the programmer wishes to refer to locations within a region using "regional" addresses (see below), an REG card must precede the first use of such addresses.

The REG card

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				REG	P 0027		0036		

defines the block 0027-0036 as region P and causes this block to be made unavailable.

Types of Addresses

Regional
A regional address has the form

| A | NNNN |

where "A" is any alphabetic character and NNNN is a four digit number. The regional address of the first word of region B, for example, is B0001. The twelfth word of region R is R0012.

Note:

1. The regional address "A"0000 is permitted. It will result in the absolute address (FWA-1).
2. Regional addresses whose absolute equivalents are larger than LWA are permitted. For example, if region R is the block 1951-1960, the regional address R0015 will assemble as 1965.
3. The use of a regional address without a defining REG card will result in the assembled address being left blank.

Symbolic
Symbolic addresses have the form

| C_5 | C_4 C_3 C_2 C_1 |

where the C's may be any characters acceptable to the alphabetic or special

character devices subject to the following restrictions:

1. C_5 must not be blank.
2. An address meant to be symbolic must not have a regional form, i.e., an alphabetic character followed by four numerical characters.

Typical symbolic addresses are

X	
X	Y
2	GS
L	OOP
F	INIS
R	EAD

N	ET
G	ROSS
T	AXES
B	ONDS
5	
F	IVE

Symbolic addresses are assigned optimum drum equivalents when initially encountered and maintain this equivalence throughout the assembly unless redefined. It is possible to preassign a value to a symbol (see EQU, SYN, pages 13, 14.)

Absolute

Absolute addresses have the form

	NNNN

where NNNN is a valid four digit machine address. The symbolizer part of an absolute address must be blank.

Drum locations corresponding to absolute addresses are not made unavailable during assembly. Thus, drum locations containing instructions or data specified by absolute addresses must be block reserved at the beginning of assembly.

Blank

Whenever the D or I address of an instruction refers to the location of the "next" instruction (or data) written on the coding form, this address and the location of the "next" instruction may be left blank provided this order is not altered when assembling. Blank addresses will be filled in optimally by the assembly program.

The D and I address of an instruction may both be blank if they both refer to the location of the next instruction written. An address should not be left blank in an instruction card unless the above meaning is specifically intended.

Operation Codes

650 operation codes may be written in either three character symbolic or two digit numerical form, e. g.,

R	AL
	65

Symbolic operation codes to be used with SOAP II are given in the Appendix.

Any card containing an illegal symbolic op code will be considered an instruction and processed accordingly. The assembled op will be left blank.

Numerical Data

Numerical data are written using the absolute part of the OP, D and I fields, e.g.,

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
			PI	31	4159		2654		
			ONE	00	0001		0000		
			FICA	00	0000		4200		

The symbolizer parts of these fields must be blank. Leading or trailing zeros must be punched in the card.

Alphabetic Data: ALF

The pseudo-op card ALF permits the programmer to enter alphabetic information into the 650 on load cards, up to five characters per card. Any characters acceptable to the alphabetic or special character devices are permissible, and are written in the D field. During assembly, alphabetic data are converted to their numerical equivalents and the latter are punched as a ten digit number in exactly the same manner as numerical data. For example,

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
			EDPM	ALF	IBMNY				

will cause the number [69, 62, 74, 75, 88] to be loaded into symbolic location EDPM.

Similarly,

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
			9010	ALF	705				

will load [00, 97, 90, 95, 00] into (core) location 9010.

Note: The I address of an ALF card is not used by SOAP II. However, if it is blank, it will be filled in by the symbol "SŌAP 2". This is merely an artifice employed to avoid erroneous error detection when listing output (See Appendix-407 Control Panel).

Signs

Any punch in column 42 signifies a negative instruction or negative data. For coding purposes, a (-) written in the sign column and punched as X (11) will suffice. A blank in column 42 is interpreted as positive.

Comments Card: Type 1

Every card processed by SOAP II may contain remarks not exceeding 10 characters in length. When longer remarks are desired, a comments card, which may contain up to 30 characters, may be used. Comments cards have no effect on the assembly. They are merely reproduced in the output deck. The following figure shows the format for comments cards. Note that the type (1) is punched in column 41.

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
	1		← C	O	M	M	E		N T S →

Example.I

Prepare a table of

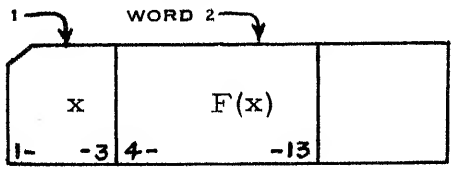
$$F(x) = Ax^2 + Bx + C$$

for

$$x = 1, 2, \ldots, 100$$

assuming A, B, C integers and $|F(x)| < 10^{10}$.

Output:



Coding is given in Figure 2. The assembled program is shown in Figure 3.

650 SŌAP II CODING FORM

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72	ACCUMULATOR		DISTRIBUTOR
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS	UPPER 8003	LOWER 8002	8001
	1		EXAMPLE		1 b CAL	C	ULATE		F OF X			
	1											
				BLR	1951		1960		READ AREA			
				REGP	0027		0028		PUNCH AREA			
	1											
			SETX	RAU	ŌNE		STX		SET X	1		
			STX	STU	P0001				TO 1	X		
				MPY	A				CALCULATE		AX	
				ALO	B				F		AX+B	
				RAU	8002					AX+B		
				MPY	P0001						(AX+B)X	
				ALO	C						(AX+B)X+C	
				STL	P0002							
				PCH	P0001				PUNCH			
				RAU	P0001				IS X MAX	X		
				SUP	XMAX					X-100		
				NZU			9999					
				AUP	101		STX		STEP X	X+1		
	1											
			ŌNE	00	0000		0001		CONSTANTS			
			XMAX	00	0000		0100					
			101	00	0000		0101					

PROBLEM _____ CODER _____ DATE _____ PAGE _____ OF _____

Figure 2 : Example 1

```
 1   1                    EXAMPLE 1 CALCULATE F OF X
 2   1
 3                  BLR     1951     1960       READ AREA
 4                  REG     P0027    0028       PUNCH AREA
 5   1
 6         SETX     RAU     ONE      STX        SET X          0000    60   0003   0007
 7         STX      STU     P0001               TO 1           0007    21   0027   0030
 8                  MPY     A                   CALCULATE      0030    19   0033   0004
 9                  ALO     B                   F              0004    15   0057   0011
10                  RAU      8002               .              0011    60   8002   0019
11                  MPY     P0001               .              0019    19   0027   0048
12                  ALO     C                   .              0048    15   0001   0005
13                  STL     P0002               .              0005    20   0028   0031
14                  PCH     P0001               PUNCH          0031    71   0027   0040
15                  RAU     P0001               IS X MAX       0040    60   0027   0081
16                  SUP     XMAX                .              0081    11   0034   0039
17                  NZU             9999        .              0039    44   0043   9999
18                  AUP     101      STX        STEP X         0043    10   0046   0007
19   1
20         ONE       00      0000     0001       CONSTANTS      0003    00   0000   0001
21         XMAX      00      0000     0100       .              0034    00   0000   0100
22         101       00      0000     0101       .              0046    00   0000   0101
```

Figure 3 : Assembly of Example 1

650 SOAP II CODING FORM

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72	ACCUMULATOR		DISTRIBUTOR
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS	UPPER 8003	LOWER 8002	8001
	1		EXAMP	LE	2 b CAL	C	U LATE		GROSS PAY			
	1											
				BLR	1951		1960		READ AREA			
				REG	P 0027		0030		PUNCH AREA			
				BLR	0000		0009		RATE TABLE			
	1											
			READ	RCD	1950				READ CARD			
				LDD	1951				STORE			IDENT
				STD	P 0001				IDENT			
				RAL	1952				GET		00,000 X,0000	
				STD	P 0002				HOURLY		RAU,000X,CG1	
				ALO	MASK		8002		RATE			
			8002	RAU	0009		CG			RATE = X.XX		
			CG	MPY	1953				CALCULATE		GROSS=XXX.XXX	HOURS = XX.X
				STD	P 0003				GROSS			
				SRD	0001				ROUND		XXX.XX	
				STL	P 0004							
				PCH	P 0001		READ		PUNCH			
	1											
			MASK	RAU	0000		CG		CONSTANT			

PROBLEM _____ CODER _____ DATE _____ PAGE _____ OF _____

Figure 4 : Example 2

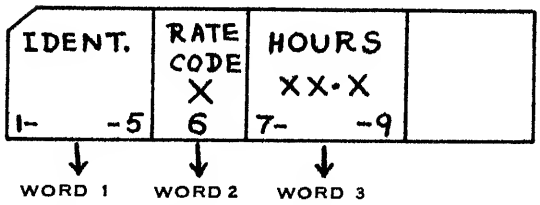
```
1    1                    EXAMPLE 2 CALCULATE GROSS PAY
2    1
3                  BLR    1951     1960      READ AREA
4                  REG    P0027    0030      PUNCH AREA
5                  BLR    0000     0009      RATE TABLE
6    1
7          READ    RCD    1950               READ CARD      0050   70   1950   0013
8                  LDD    1951               STORE          0013   69   1951   0054
9                  STD    P0001              IDENT          0054   24   0027   0080
10                 RAL    1952               GET            0080   65   1952   0057
11                 STD    P0002              HOURLY         0057   24   0028   0031
12                 ALO    MASK     8002      RATE           0031   15   0034   8002
13          8002   RAU    0009     CG                       8002   60   0009   0063
14         CG      MPY    1953               CALCULATE      0063   19   1953   0024
15                 STD    P0003              GROSS PAY      0024   24   0029   0032
16                 SRD    0001               ROUND          0032   31   0001   0039
17                 STL    P0004                             0039   20   0030   0033
18                 PCH    P0001    READ      PUNCH          0033   71   0027   0050
19   1
20         MASK    RAU    0000     CG        CONSTANT       0034   60   0000   0063
```

Figure 5 : Assembly of Example 2

Example II

Given a rate code and number of hours worked, search a rate table and calculate gross pay.

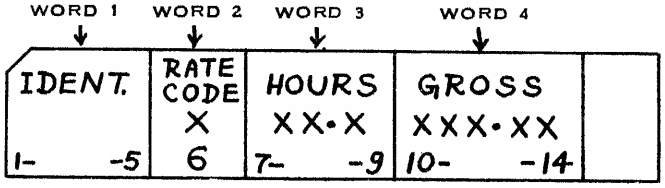
Input:



Word 1: 00000, xxxxx = Identification
Word 2: 00, 000x, 0000 = Rate Code
Word 3: 00 00000 xx.x = Hours

The rate code is a one digit number 0-9. The corresponding hourly rate (x.xx) is in the low three positions of locations 0000-0009.

Output:



Coding is shown in Figure 4. The assembled program is given in Figure 5.

Indexing

When the D or I address of an instruction is to be modified by an indexing register, the corresponding TAG column is used to indicate the appropriate indexing register. Permissible tags are A, B, C or 1, 2, 3. The assembly program will automatically add the proper multiple of 2,000 or 200 to a tagged address.

For example, the following program will perform the vector addition $x_i + y_i = z_i$, i = 1, 2, ..., 100. The x_i are stored in region X, y_i in region Y and z_i in region Z.

COL. 41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
			RSA	0100		ADD		
		ADD	RAL	X0101	A			
			ALO	Y0101	A			
			STL	Z0101	A			
			AXA	,0001				
			NZA	ADD				

The following types of D or I addresses will not be indexed even if a tag is present:

1. Undefined symbolic
2. Blank
3. Not in the range 0000-1999 or 9000-9059.

Predefining Symbols

The following two pseudo operations may be used to preassign a value to a symbolic address:

Equivalence: EQU
The symbol written in the D address is assigned the equivalent of the expression written in the I address. The I address may be absolute, regional or symbolic. If the I address is regional or symbolic, it must have been previously defined.

The EQU card

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				EQU	TAPE1		8010		

will cause the symbol TAPE 1 to be assigned the value 8010 whenever it subsequently appears during assembly.

The EQU card

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				EQU	CODE		R0002		

will cause the symbol CODE to be assigned the value R0002, i. e., the second word of region R. Region R must have been previously defined by an REG card.

Similarly, the EQU card

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				EQU	ALPHA		BETA		

will assign to ALPHA the value previously assigned to BETA.

Synonym: SYN

An SYN card is exactly like an EQU card except that the equivalent of the expression written in the I address must be a drum address, i.e., $0000 \leq$ "I" ≤ 1999. This drum location is made unavailable to the program. The I address may be absolute, regional or symbolic.

The SYN card

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				SYN	ENTRY		1205		

will assign the value 1205 to the symbol ENTRY and reserve location 1205.

If the I address of an EQU or SYN card is undefined, the card will be ignored. EQU or SYN takes precedence over any previous definition.

Assembly Capacity and Speed

During assembly, all symbolic addresses and their equivalents are stored in a symbol table which can accommodate 400 symbols. Programs containing more than 400 symbolic addresses should be assembled in separate blocks. Non-overlap can be guaranteed by use of an availability punchout described in the next section.

Assembly progresses at the rate of 50 to 90 cards per minute. This will decrease somewhat if the symbol table becomes densely packed or if few drum locations are available for the remaining program.

Punching Availability Table: PAT

The availability table is a 200 word table used by SOAP II to "remember" those drum locations already used and those still remaining. The pseudo-op PAT can be used at any time during assembly to cause punching of this table in a highly readable form. The output will be fifty Type Y (12) cards, one for each dynamic drum level (00-49). These cards may be listed with the 407 control panel described in the Appendix. This listing will reveal at a glance all drum locations used by the program (0) and those remaining (1) for additions or corrections.*

The availability table may be loaded as input to an assembly thus restoring the

*See page 91.

availability status which existed at some point of a prior assembly.

Order of Assembly Deck

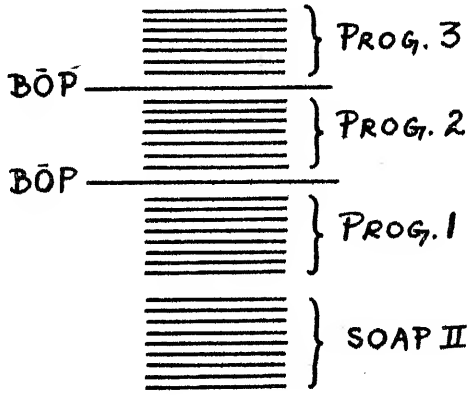
The assembly input deck should have the following order:

1. SOAP II
2. Deck to be assembled

Due to the one pass nature of the assembly, priority for the choice of optimal locations diminishes as the assembly progresses. Thus, frequently executed portions of the program should be placed toward the beginning of the assembly deck.

Multifile Assembly: BŌP

Any number of independent programs may be assembled in one pass. Merely place a pseudo-op card BŌP (Beginning of Program) between each program, i. e.,



Note that it is redundant to place a BŌP card before the first of one or more programs to be assembled.

Machine Operator's Guide

1. 533 Read-Punch Unit
    a. Insert SOAP II control panel
    b. Ready read feed with assembly deck
    c. Ready punch feed with blanks

2. 650 Console
    a. Set programmed switch to STOP
    b. Set half cycle switch to RUN

c. Set control switch to RUN
d. Set display switch to DISTRIBUTOR
e. Set overflow switch to SENSE
f. Set error switch to STOP

3A. If SOAP II is being loaded, set (70, 1951, 9999) in storage entry switches.

3B. If SOAP II is already on the drum, do one of the following:
1. Set (00, 0000, 1000) in storage entry switches.
2. Precede input with a BOP card and set (00, 0000, 1950) in storage entry switches.

4. Press computer-reset key
5. Press program-start key
6. When read hopper empties, press end of file key
7. The availability table may be obtained manually by sending control to location 1900.

Programmed Stops

0111-Symbol table full; pressing program-start key will continue assembly. Symbolic address which cannot be assigned an equivalent will be left blank in the output.

0222-Drum packed, i.e., no locations available for remaining program. Pressing program-start key will continue assembly. Addresses which cannot be assigned will be left blank in the output.

There are no other programmed stops.

APPENDIX

Heading: HED

Heading is used to avoid duplicity of symbols when several programs or several sections of a single program are to be assembled together. The need for heading is paramount if several persons have contributed to a program or when a program employs symbolic library routines.

Heading is accomplished in SOAP II by the automatic insertion of a heading character into the right-most position of symbols having this position blank. The heading character is punched in the symbolizer part of the D address of a HED card. Thus the symbol

| T | W Ō b b |

(b = blank)

subsequent to the heading card

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				HED	Z				

is processed by the assembly program as if it were actually the symbol

| T | W Ō b Z |

In order to make effective use of heading, it is necessary to agree before hand to restrict all symbols to four characters or less.* Prior to assembly, each of the various sections of the program is preceded by an appropriate HED card.

If within a section of the program headed by "A" it is desired to refer to the symbol (TAX bb) appearing in a section headed by F, simply use the symbol (TAX bF). The small b, for blank column, is necessary to prevent the card punch operator from closing up the symbol and thus taking the "F" out of the heading column.

*If a symbol is to be referred to by several headed parts of the program, then it is best that this symbol not be headed anywhere. This can be accomplished by making it a five-character symbol.

The effect of a heading card is terminated only by another heading card. If it is desired to terminate a heading card without introducing a new heading, use a HED card with a blank D address. Any character acceptable to the alphabetic or special character devices may be used for heading.

800X Instructions

When the D or I address of an instruction located in 800X (X = 0, 1, 2, 3, 5, 6, 7) is to be optimized by the assembly program, an instruction located in 800X should be written on the coding form. 800X instructions will be automatically bypassed when loading the assembled output.

Use of Library Programs

Within the framework of SOAP II, library programs are in either symbolic or relocatable form. Both of these forms are discussed in the following two sections.

Symbolic Library Programs

Symbolic library programs are written in exactly the same form as the main program. Except for the entry and exit symbols, all symbols are four characters or less. They may thus be conveniently headed. It is important to note that such programs do not incorporate a "guaranteed" optimization.

Relocatable Library Programs: REL

Whenever tight optimization is required, one should use relocatable library programs. These are coded in absolute and may be translated an amount specified by the programmer. This is accomplished by use of the pseudo operation REL (relocate). The number punched in the absolute D address specifies the amount of drum translation, Δ_D. Similarly, the absolute I address specifies the amount of core translation, Δ_C. A blank field is interpreted as zero. Thus

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				REL	1200		0010		

would cause drum addresses in the relocatable program following it to be incremented by 1200 and core addresses by 10. The REL card

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				REL	0600				

will increment subsequent drum addresses by 600 and core addresses by 0. Only positive translations are permitted.

Relocatable library programs must be assembled prior to the main program. The programmer need not block reserve the drum area used by a relocatable program. This is automatically performed by the assembly program.

The effect of an REL card is terminated only by another REL card.

If a translated drum location is greater than 1999, it is left blank in the output. The same applies to a translated core location greater than 9059.

Writing Library Programs

The following two sections are of primary interest to programmers responsible for writing SOAP II library routines.

Symbolic Library Programs

Entry and exit symbols should be five characters to avoid heading difficulties. All other symbols should be four characters or less to permit heading by the user.

Relocatable Library Programs

Relocatable programs are written in absolute and should use the lowest possible drum or core locations in the unrelocated state. The following rules apply specifically to these routines:

1. A relocatable card is indicated by a 2 punch in the type column (41).
2. Op codes may be symbolic or numerical
3. L may be drum or core.
4. D and I may be absolute or symbolic.*

*Symbolic D or I addresses may occasionally be required to refer to other routines.

5. Absolute addresses may be one of five varieties:

   a. Non-relocatable (Fixed): |F ¦ NNNN|
   b. Drum relocatable:| ¦NNNN | ; 0000 ≦ NNNN ≦ 1999
   c. Core relocatable: | ¦NNNN | ; 9000 ≦ NNNN ≦ 9059

where NNNN is a four-digit number. In situations where D or I is relocatable but not in the range (b) or (c), the usage

   d. Drum relocatable: |D ¦ NNNN|
   e. Core relocatable: |C ¦ NNNN|

will eliminate possible ambiguity.

6. Absolute D or I addresses in the range 0000-1999 or 9000-9059 after possible relocation may be tagged for indexing by the assembly program.

7. If L, after possible relocation, is a drum address, it will be made unavailable. D or I drum addresses are not reserved.

Two pseudo operations, RBR and REQ are designed for use with relocatable programs.

Relocatable Block Reservation: RBR

The pseudo operation RBR is identical to BLR except that the drum addresses FWA, LWA are incremented by Δ_D prior to reservation. For example, if Δ_D = 1000,

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				RBR	0025		0050		

will cause drum locations (1025-1050) to be reserved.

The use of RBR is mainly for drum routines which use erasable blocks within the routine. Reservation of these blocks is easily accomplished with RBR cards thus avoiding the necessity of a large number of cards simply to reserve erasable areas.

Relocatable Equivalence: REQ

The pseudo operation REQ enables symbolic linkage of the main program with relocatable programs. REQ is similar to EQU except that the absolute I address is incremented by Δ_C or Δ_D prior to being assigned as the equivalent of the

symbol in the D address. The I address must be absolute, type (b) or (c) (see 5 above). Thus if Δ_C = 0020,

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				REQ	RAMAC		9010		

will assign 9030 as the equivalent of the symbol "RAMAC".

Similarly, if Δ_D = 1300,

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				REQ	TYPE3		0075		

will assign 1375 as the equivalent of the symbol "TYPE 3."

To illustrate a typical drum-drum* relocatable subroutine, the program given in Figure 6, using indexing registers, will evaluate the polynomial

$$F(x) = a_n x^n + a_{n-1} x^{n-1} + \ldots . \quad a_0$$

where $n \geq 0$ and x, a_i are floating point numbers. The a_i's are stored such that

$$L(a_i) = L(a_0) + i$$

The calling sequence is

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
				RAL	CW				
				LDD	X				
				RAC	NEXT		POLYX		

where

$$CW = \begin{cases} \left[00,\ \{L(a_0) + 2000\},\ n\right] & \text{if the } a_i \text{ are on the drum} \\ \left[00,\ \{L(a_0) + 200\},\ n\right] & \text{if the } a_i \text{ are in core} \end{cases}$$

The routine will exit to (drum location) NEXT with the result in the upper accumulator.

*Loaded onto and executed from the drum.

COL. 41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
2		0009	STD	0013		0016		SAVE X
2		0016	LDD	0019		0011		SET ADDR. OF a_0
2		0011	SDA	0019		0001		
2		0001	RAA	F 8002		0010		$n \rightarrow$ I.A. A
2		0010	FMP	0013		0019		$(\ ) \cdot X$
2		0019	FAD	F 9999		0002		$(\ ) \cdot X + a_i \rightarrow (\ )$
2		0002	NZA	0005		F 0000	C	IS $n = 0$
2		0005	SXA	F 0001		0010		$n-1 \rightarrow n$
2		0013	01	F 0000		F 0000		ERASEABLE (X)
			REQP	ŌLYX		0009		DEFINE ENTRY

Figure 6: Relocatable Drum-Drum Subroutine

The relocatable drum-core* subroutine given in Figure 7 will evaluate K! where $K > 0$ and $K! < 10^{10}$. The calling sequence is

COL. 41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
			RAL	K				
			LDD	EXIT		CALKF		

The result will be in the lower accumulator on exiting from the subroutine. Note that whereas seven core locations are required for execution, only six drum locations are needed to store the subroutine. Savings of this kind may usually be effected by placing erasable locations at the end of drum-core routines.

*Loaded onto the drum and executed in core.

COL.	41	42	43 44- -47	48 49, 50	51 52- -55	56	57 58- -61	62	63- -72
	TYPE	SIGN	LOCATION	OPERATION CODE	DATA ADDRESS	TAG	INSTRUCTION ADDRESS	TAG	REMARKS
	2		0000	STD	9006		9001		STORE EXIT
	2		0001	RAA	F 8002		9002		K → I.A. A
	2		0002	SXA	F 0001		9003		(K-1) IN I.A. A
	2		0003	NZA	9004		9006		IS (K-1) = 0
	2		0004	RAU	F 8002		9005		( ) → UA
	2		0005	MPY	F 8005		9002		( )(K-P)
				REQ	CALKF		9000		DEFINE ENTRY

Figure 7: Relocatable Drum-Core Subroutine

SYMBOLIC 650 OPERATION CODES

Numerical	Symbolic*	Operation
00	NOP	No Operation
01	HLT	Halt
02	UFA	Unnormalized Floating Add
03	RTC	Read Tape Check
04	RTN	Read Tape Numeric
05	RTA	Read Tape Alphanumeric
06	WTN	Write Tape Numeric
07	WTA	Write Tape Alphanumeric
08	LIB	Load I.A.S. Block
09	LDI	Load I.A.S.
10	AUP	Add Upper
11	SUP	Subtract Upper
12	-	(Not Used)
13	-	(Not Used)
14	DIV	Divide
15	ALO	Add Lower
16	SLO	Subtract Lower
17	AML	Add Magnitude to Lower
18	SML	Subtract Magnitude from Lower
19	MPY	Multiply

*All O's in symbolic OP codes are alphabetic O's, not numerical zeros.

Numerical	Symbolic	Operation
20	STL	Store Lower
21	STU	Store Upper
22	SDA	Store Data Address
23	SIA	Store Instruction Address
24	STD	Store Distributor
25	NTS	Branch No Tape Signal
26	BIN	Branch on Inquiry
27	SET	Set I.A.S. Ring
28	SIB	Store I.A.S. Block
29	STI	Store I.A.S.
30	SRT	Shift Right
31	SRD	Shift and Round
32	FAD	Floating Add
33	FSB	Floating Subtract
34	FDV	Floating Divide
35	SLT	Shift Left
36	SCT	Shift Left and Count
37	FAM	Floating Add Magnitude
38	FSM	Floating Subtract Magnitude
39	FMP	Floating Multiply

Numerical	Symbolic	Operation
40	NZA	Branch Non-Zero I.R. A
41	BMA	Branch Minus I.R. A
42	NZB	Branch Non-Zero I.R. B
43	BMB	Branch Minus I.R. B
44	NZU	Branch Non-Zero Upper
45	NZE	Branch Non-Zero
46	BMI	Branch Minus
47	BOV	Branch on Overflow
48	NZC	Branch Non-Zero I.R. C
49	BMC	Branch Minus I.R. C
50	AXA	Add I.R. A
51	SXA	Subtract I.R. A
52	AXB	Add I.R. B
53	SXB	Subtract I.R. B
54	NEF	Branch No End of File
55	RWD	Rewind
56	WTM	Write Tape Mark
57	BST	Backspace Tape
58	AXC	Add I.R. C
59	SXC	Subtract I.R. C

Numerical	Symbolic	Operation
60	RAU	Reset Add Upper
61	RSU	Reset Subtract Upper
62	-	(Not Used)
63	-	(Not Used)
64	DVR	Divide Reset Upper
65	RAL	Reset Add Lower
66	RSL	Reset Subtract Lower
67	RAM	Reset Add Magnitude into Lower
68	RSM	Reset Subtract Magnitude into Lower
69	LDD	Load Distributor
70*	RD1	Read Input Storage 1
71*	WR1	Write Output Storage 1
72	RC1	Read Conditional Input Storage 1
73	RD2	Read Input Storage 2
74	WR2	Write Output Storage 2
75	RC2	Read Conditional Input Storage 2
76	RD3	Read Input Storage 3
77	WR3	Write Output Storage 3
78	RC3	Read Conditional Input Storage 3
79	RPY	Reply

*SOAP II will also accept the symbolic op codes

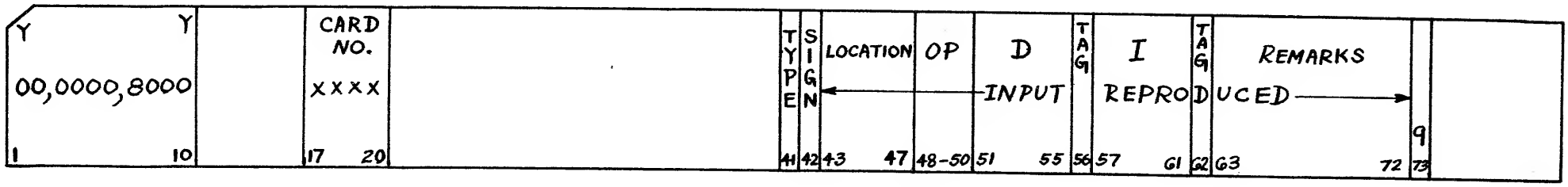
70 RCD Read Card
71 PCH Punch

Numerical	Symbolic	Operation
80	RAA	Reset Add I.R. A
81	RSA	Reset Subtract I.R. A
82	RAB	Reset Add I.R. B
83	RSB	Reset Subtract I.R. B
84	TLU	Table Lookup
85	SDS	Seek Disk Storage
86	RDS	Read Disk Storage
87	WDS	Write Disk Storage
88	RAC	Reset Add I.R. C
89	RSC	Reset Subtract I.R. C
90	BDO	Branch on 8 in Distributor 10
91	BD1	Branch on 8 in Distributor 1
92	BD2	"
93	BD3	"
94	BD4	"
95	BD5	"
96	BD6	"
97	BD7	"
98	BD8	"
99	BD9	Branch on 8 in Distributor 9

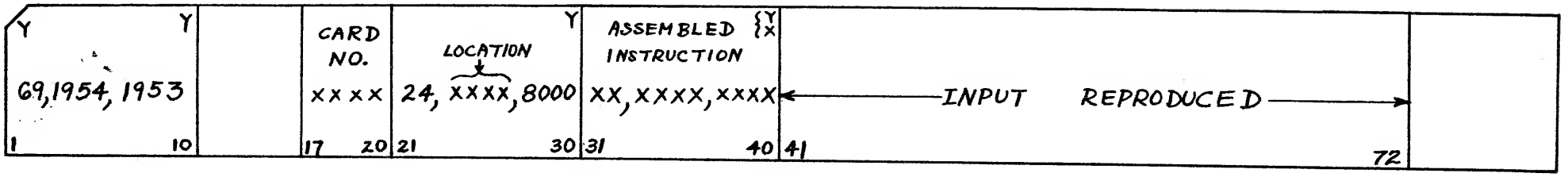
COL.	41	42	43	44- -47	48	49, 50	51	52- -55	56	57	58- -61	62	63- -72
	TYPE	SIGN		LOCATION		OPERATION CODE		DATA ADDRESS	TAG		INSTRUCTION ADDRESS	TAG	REMARKS
					B	LR		FWA			LWA		
					B	LA		FWA			LWA		
					R	EG	*	FWA			LWA		* = ALPHABETIC CHAR.
					E	QU	S	YMBL			ANY		
					S	YN	S	YMBL			ANY		
					A	LF	X	XXXX					
					B	OP							
					H	ED	#						# = HEADING CHAR.
					P	AT							
					R	EL		Δ_D			Δ_C		
					R	BR		FWA			LWA		
					R	EQ	S	YMBL			NNNN		

Summary of Pseudo Operations

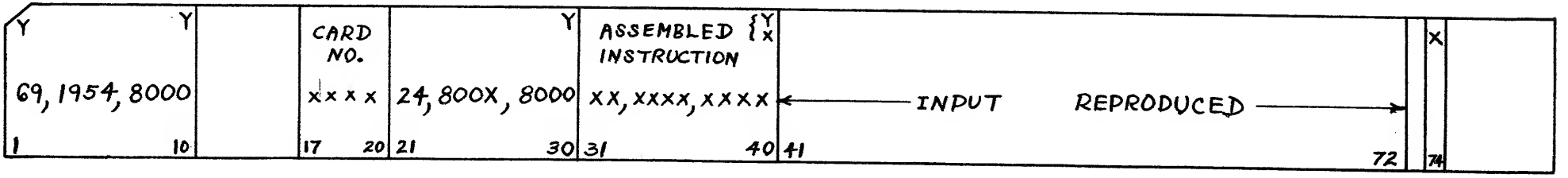
Pseudo Operations except ALF



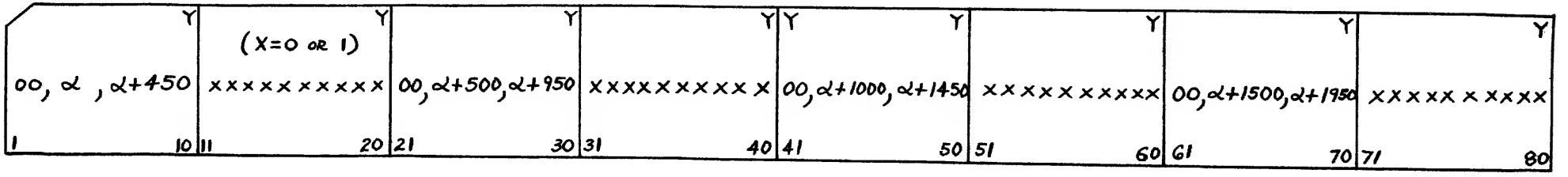
Instructions, Data and ALF



800X Instructions



Availability Table: $00 \leqq \alpha \leqq 49$



DESCRIPTION OF OUTPUT CARDS

407 Control Panel

The 407 control panel shown in Figure 9 will detect the following situations in the assembled output:

Note #

1 - Instruction * with blank L following an instruction with D and I both not blank.
2 - Instruction with L not blank following an instruction with either D or I blank.
3 - Instruction with blank L not preceded by an instruction.
4 - Non-instruction following an instruction with D or I blank.

Notes (1) and (2) always imply a coding error while (3) and (4) are warning signals to point out potential coding errors.

If the assembled L, OP, D or I fields of an instruction have been left blank, columns 75-78, respectively, will be x (11) punched. Correspondingly, the phrase

BLANK L, OP, D or I

will print to the right of the absolute instruction.

If an EQU or SYN card has been ignored due to an undefined I address or a packed symbol table, column 79 will contain a 9 punch causing the word "BYPAS" to print to the right of the Remarks field.

*Instruction → instruction or data.

IBM
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READ-PUNCH UNIT, TYPE 533 CONTROL PANEL

(USED WITH TYPE 650 MAGNETIC DRUM DATA-PROCESSING MACHINE)

Form No. 22-6207-1
Printed in U.S.A.

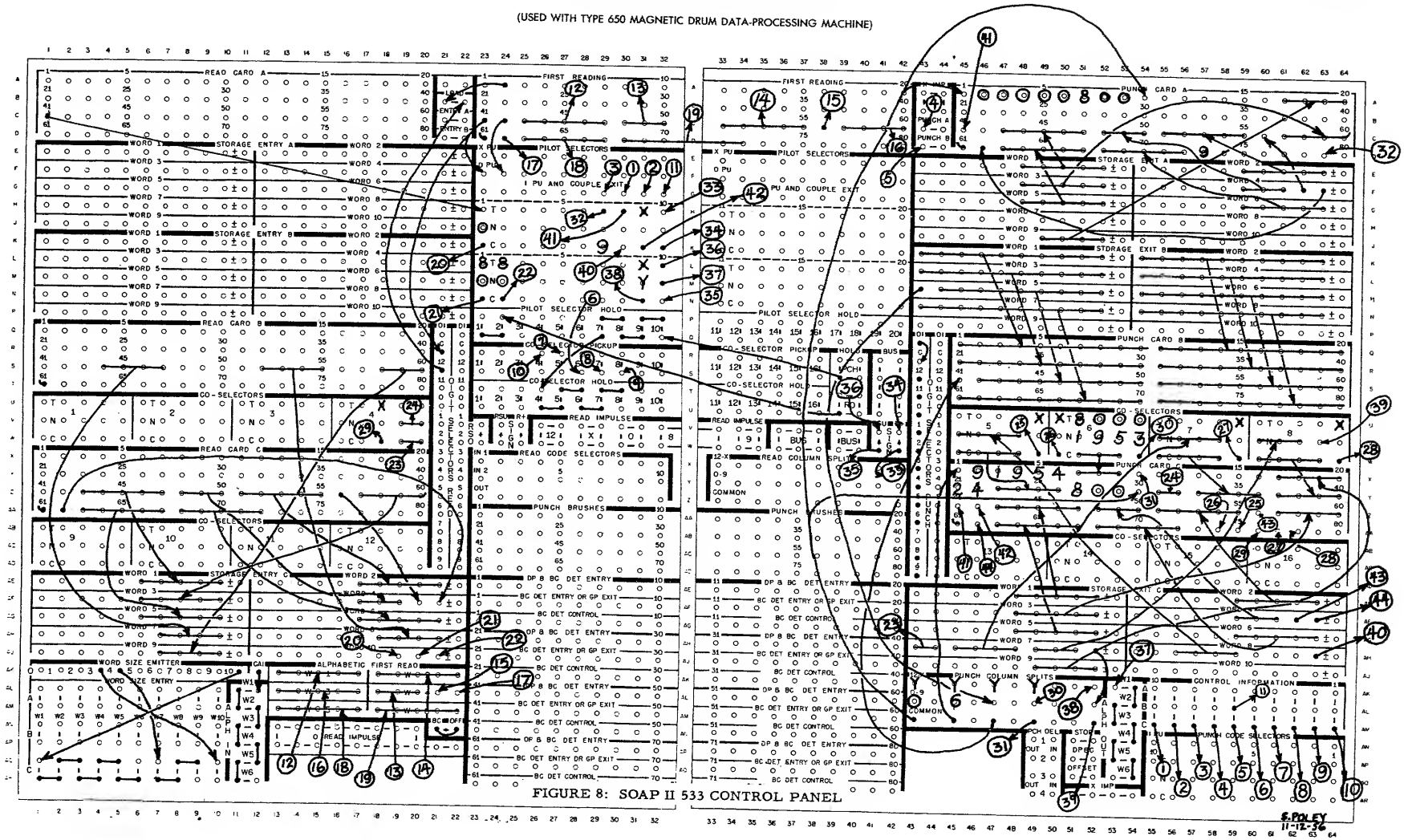


FIGURE 8: SOAP II 533 CONTROL PANEL

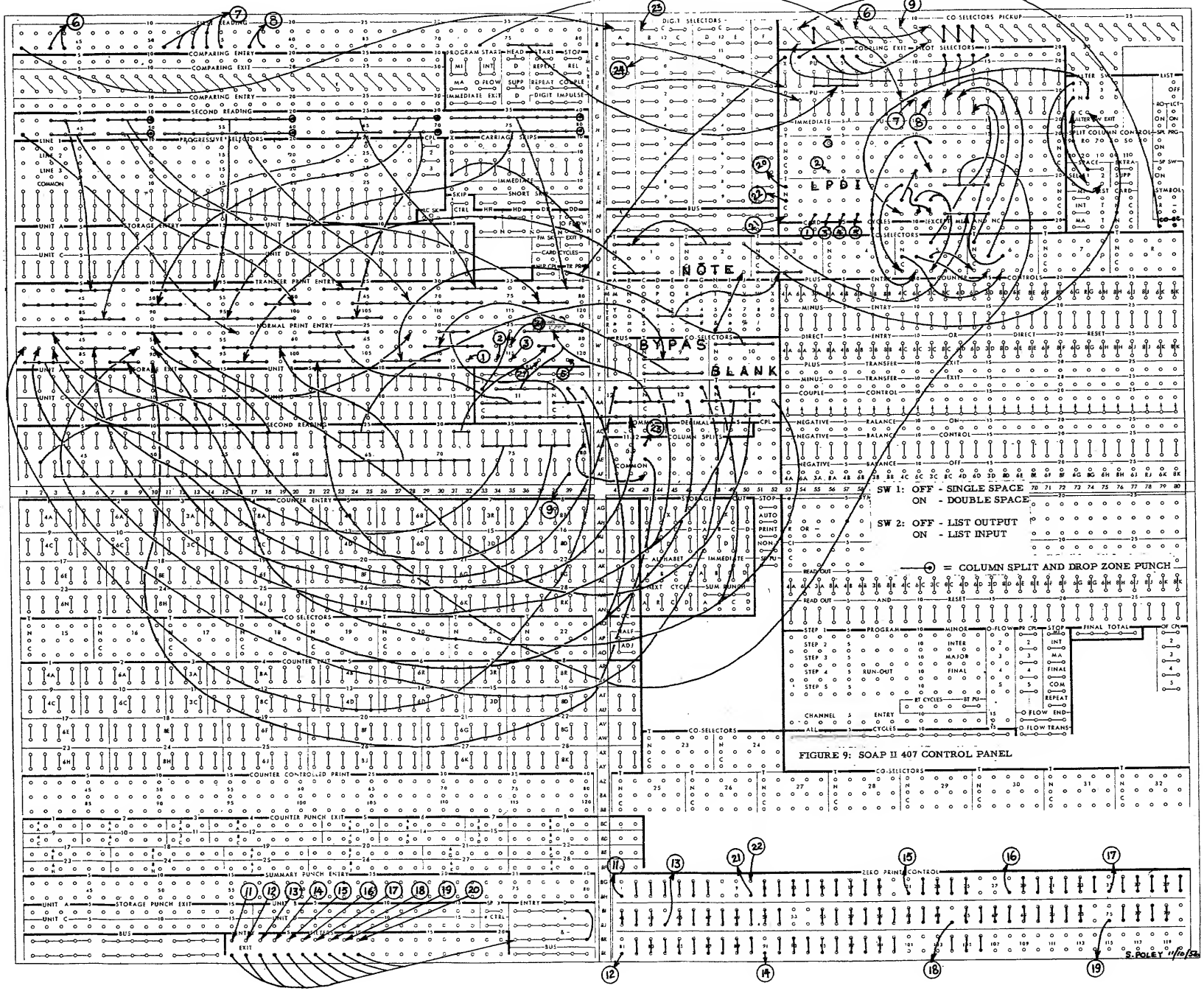


FIGURE 9: SOAP II 407 CONTROL PANEL

PART II : PROGRAM ANALYSIS

Introduction

The following is a description of the internal operation of SOAP II. An attempt has been made to present this description in a logical order beginning with allocation of memory followed by an explanation of the tables governing the assembly and outline of the various subroutines.

The symbolic assembly of SOAP II included at the end of this report was arrived at in the following manner:

1. SOAP II was coded symbolically for assembly by SOAP I.
2. Deck (1) was assembled by SOAP I, giving SOAP II in SOAP I form.
3. Deck (1) was translated into SOAP II symbolic form using the SOAP I to SOAP II Translator (N.Y.S.C.C. #334).
4. The symbolic SOAP II form of SOAP II (3) was assembled by Deck (2) giving SOAP II in SOAP II form.

The program is listed in logical order as opposed to the order in which it was assembled.

Memory Allocation

Figure 1 is a "snapshot" of the drum showing the location of the various tables used by the assembly program and the input-output and program blocks.

Table Descriptions

Symbol Table: 0000-0399

Every symbol processed by the assembly program is stored in the symbol table. An attempt is first made to store a symbol in location L_0 computed as follows:

Let S = XXXXXXXXXX be the ten digit numerical representation of a five alphanumerical character symbol. Calculate

(1001001001) X (S) = YYYYYYYYYY(ZZZ)YYYYYYY

Then L_0 is taken to be the integral part of .4(ZZZ). Thus $000 \leqq L_0 \leqq 399$. It may be seen that all of the digits in S contribute to the formation of L_0. Thus different symbols will tend to give rise to different L_0's, but the problem of duplicity, i.e., different symbols having the same L_0, must be accounted for. If a symbol cannot be stored in L_0 (because another symbol has "gotten

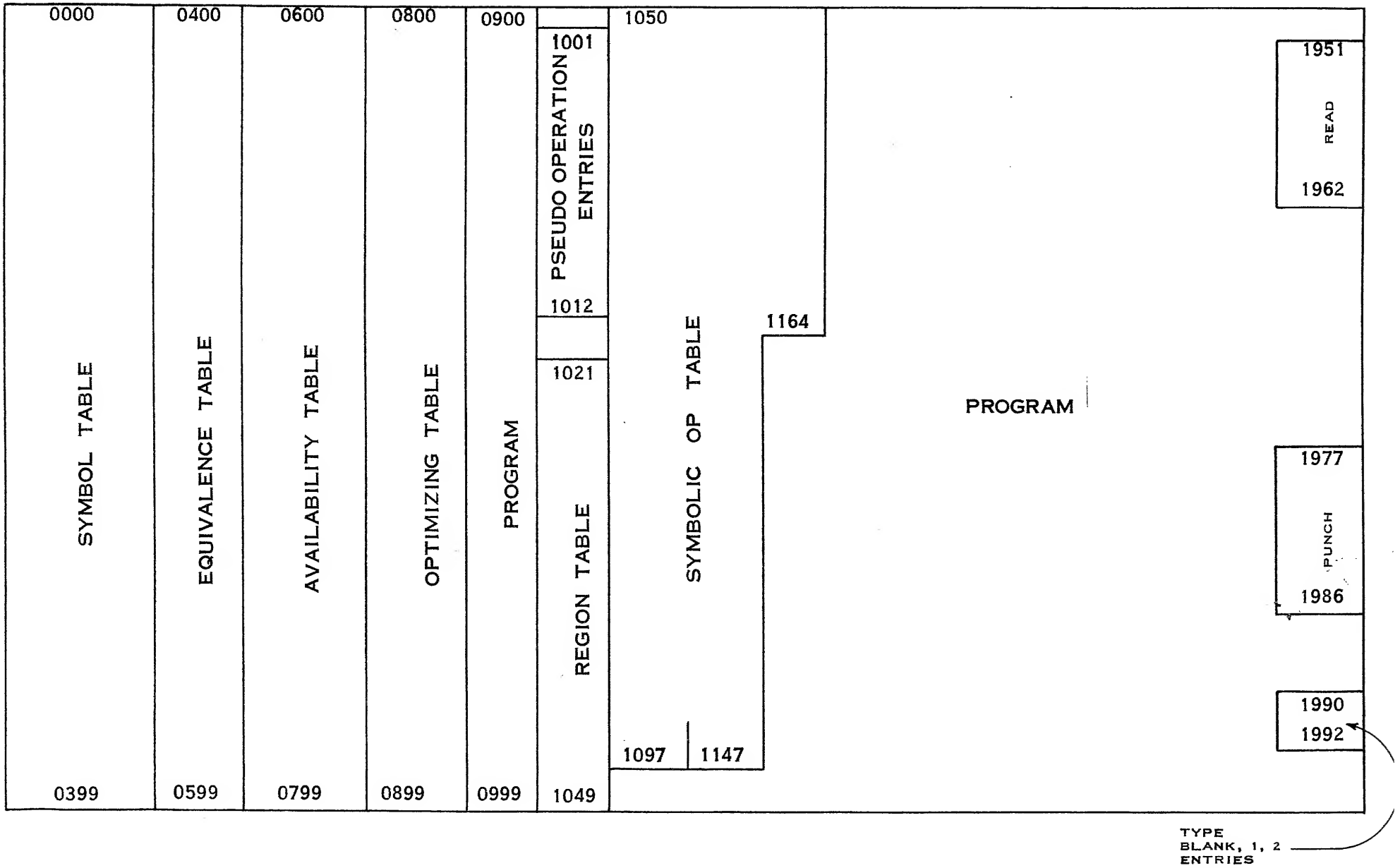


FIGURE 1: MEMORY ALLOCATION

there first"), an attempt is made to store it in (L_0 + 1). If this too fails, we try L_0 + 2, L_0 + 3, ..., L_0 + K where K is (hopefully) small.

Equivalence Table: 0400-0599

Whenever a symbol is stored in the symbol table, its four digit equivalent is stored in the equivalence table in the following manner:

Let L be the location in the symbol table containing the symbol. Let

$$\frac{L}{2} = Q + \frac{R}{2}$$

Then the equivalent is stored in the data address or instruction address part of (0400 + Q) according as R = 0 or 1.

Availability Table: 0600-0799

The availability table "remembers" drum locations used by the program being assembled and those still remaining. Each of the 200 words contains indicator digits (0 → unavailable, 1 → available) for ten dynamically equivalent drum locations. If these digits are numbered from left to right, P = 0, 1, 2, ..., 9, then the digit corresponding to a drum location L may be found as follows:

Let $L = X_1X_2X_3X_4$. Let $2L = Y_1Y_2Y_3Y_4$.

Then

$$A = 0600 + Y_1 + 2(Y_3Y_4)$$

$$P = Y_2$$

where A is the availability table location whose P^{th} digit corresponds to L.

Example:

L = 1238
2L = 2476
A = 0600 + 2 + 2(76) = 0754
P = 4

Conversely, given A and P, one may compute L as follows:

Let $\frac{A-0600}{4} = Q + \frac{R}{4}$

Then L = 500R + 50P + Q

Example: A = 0754, P = 4

$$\frac{0754 - 0600}{4} = \frac{154}{4} = 38 + \frac{2}{4}$$

$$L = 500 \times 2 + 50 \times 4 + 38 = 1238$$

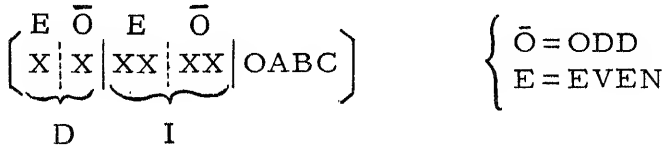
Optimizing Table: 0800-0899

Information required to optimize 650 instructions is stored in the optimizing table. Location (0800 + XX) contains the entry for numerical op code XX where $00 \leq XX \leq 99$. Thus the entry for RAL (65) is in 0865.

As there is no one rule by which all 650 instructions may be optimized, operations having the same or similar optimizing rules have been grouped as shown in Figure 2. The general optimizing rules for these groups are:

999:	$I = D + \delta$	where $\delta = f(D)$
998:	$I = L + \delta$	where $\delta \neq f(D)$
898:	$I = L + \delta$	where $\delta = f(D)$, non-shift
988:	$I = L + \delta$	shift other than SRD
888:	$I = L + \delta$	SRD

Optimizing table entries have the following format:



where ABC is the group code given in Figure 2. Thus the entry for RAL is (3305040999).

GROUP CODE	OPERATIONS
999	UFA, AUP, SUP, DIV, ALO, SLO, AML, SML, MPY, STL, STU, SDA, SIA, STD, FAD, FSB, FDV, FAM, FSM, FMP, RAU, RSU, DVR, RAL, RSL, RAM, RSM, LDD, LIB, LDI, SIB, STI, TLU, RD1, WR1, RC1, RD2, WR2, RC2, RD3, WR3, RC3, RCD, PCH, RPY
998	NOP, HLT, RTC, RTN, RTA, WTN, WTA, NTS, BIN, SET, NZA, BMA, NZB, BMB, NZC, BMC, NZU, NZE, BMI, BOV, NEF, RWD, WTM, BST, BDO, BD1, ..., BD9, SDS, RDS, WDS
898	AXA, SXA, AXB, SXB, AXC, SXC, RAA, RSA, RAB, RSB, RAC, RSC
988	SRT, SLT, SCT
888	SRD

Figure 2: 650 Operation Groups

Pseudo Operation Entries: 1001-1012

The twelve pseudo operations have been (arbitrarily) numbered as follows:

#	Pseudo Operation
1	BOP
2	BLR
3	BLA
4	REG
5	EQU
6	SYN
7	ALF
8	PAT
9	HED
10	REL
11	REQ
12	RBR

The first instruction of a pseudo operation is in location (1000 + #). Thus the REL routine begins in 1010.

Region Table: 1021-1049

Origins of the twenty-six possible regions are stored in the region table. The instruction address part of location (0960 + XX) contains the first word address (FWA) of the region having XX as the numerical representation of its alphabetic designation. Thus the origin of region F is in 1026 (= 0960 + 66).

The region table is initialized to (8000000000). Processing of an REG card with FWA = YYYY converts the appropriate entry to (900000YYYY).

Symbolic Op Table: 1050-1164 except 1098-1099 and 1148-1149

All pseudo operation codes and symbolic 650 operation codes are stored in the symbolic op table. The table is in ascending order on the six high digits of each entry representing the numerical representation of the alphanumerical op code.

The table entry for RAL, for example, is (7961730065) while that for REL is (7965731010). Thus the I address part of pseudo operation entries is the location of the first instruction of the pseudo routine while the two low order digits of 650 symbolic op code entries are the corresponding numerical op.

Type Entries: 1990-1992

The first instruction for types "blank", 1 and 2 is in location 1990, 1991, 1992 respectively.

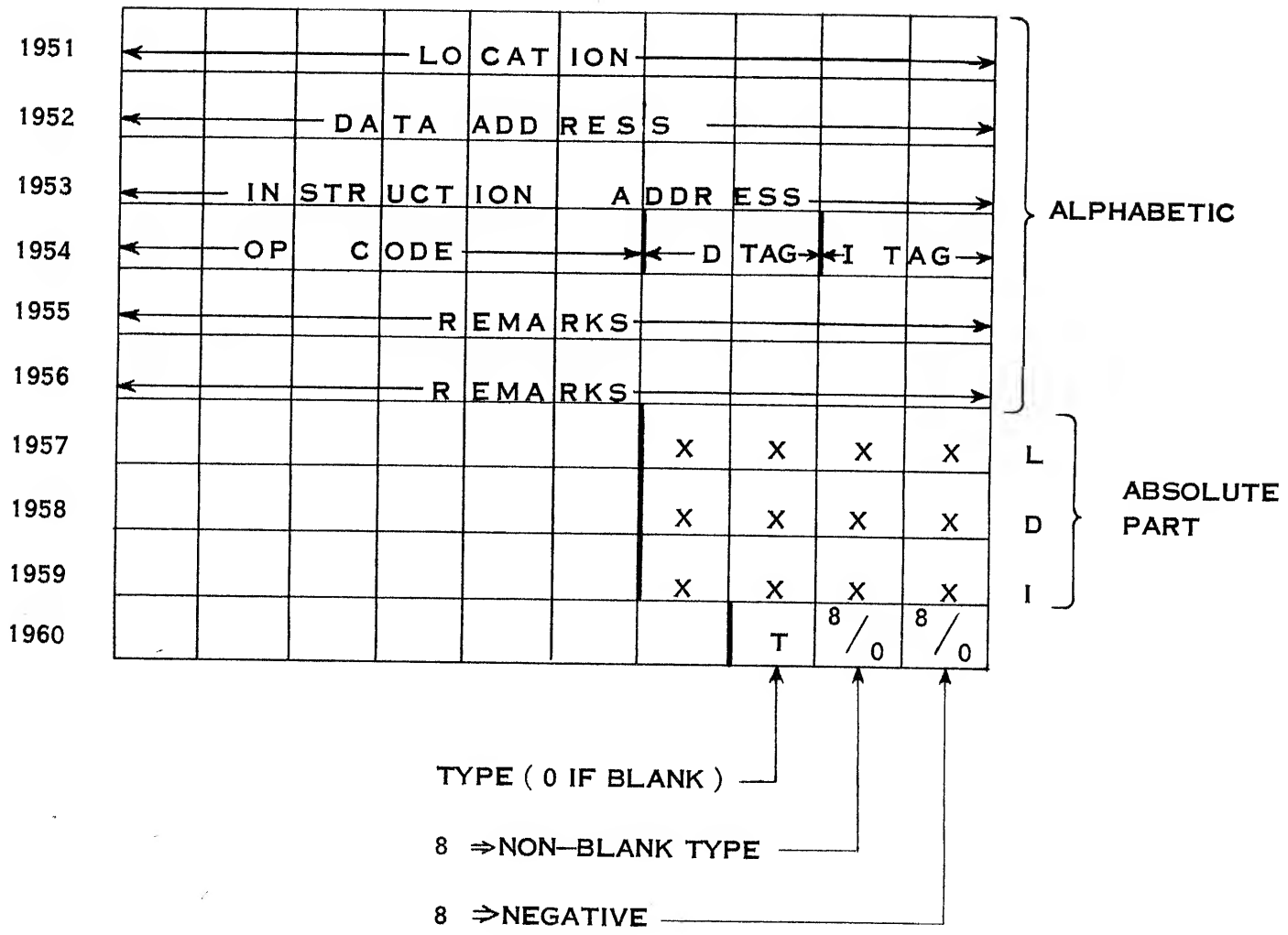


FIGURE 3: INPUT BLOCK : 1951 — 1960

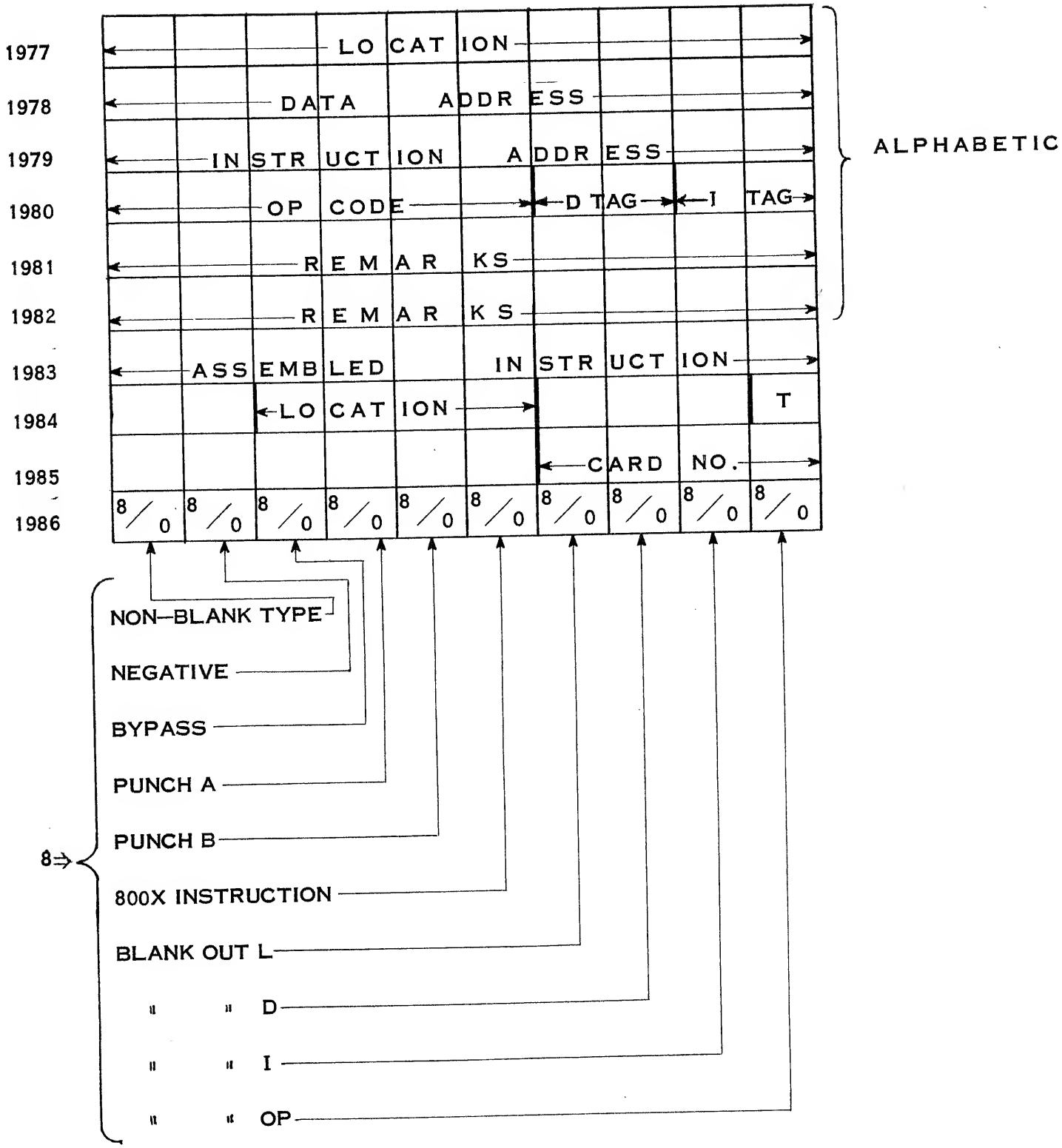


FIGURE 4: OUTPUT BLOCK: 1977 – 1986

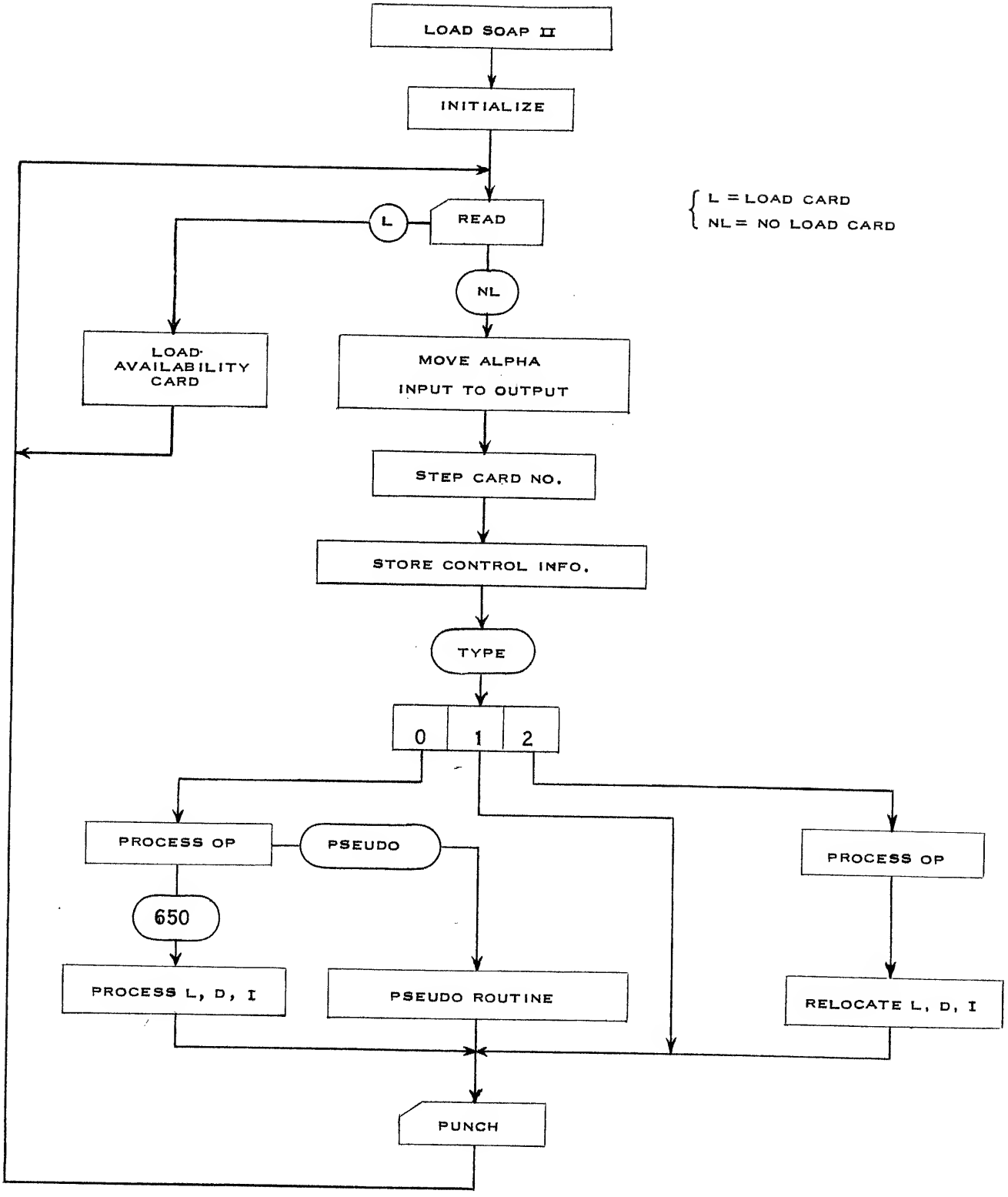
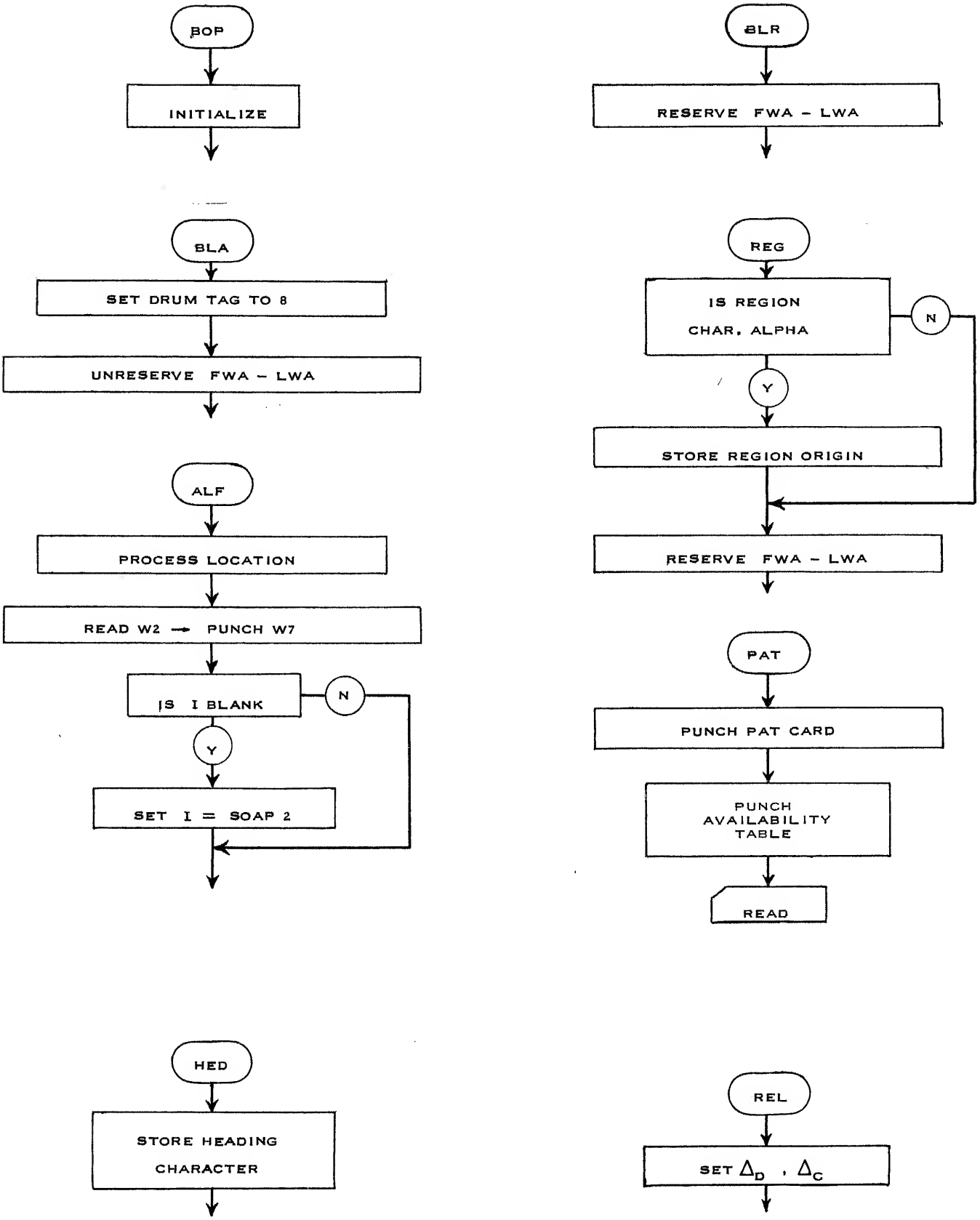
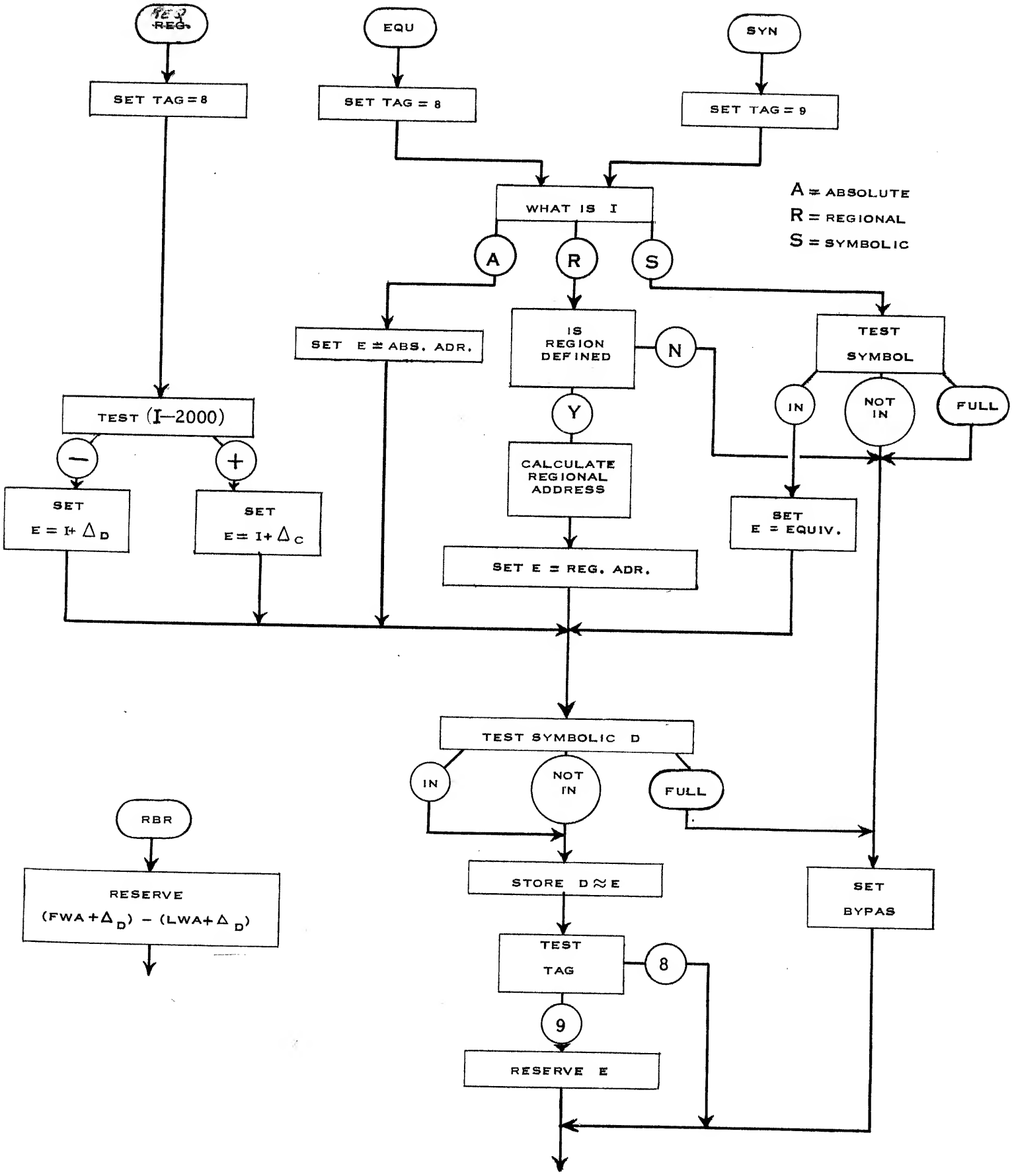


FIGURE 5: BASIC FLOW CHART

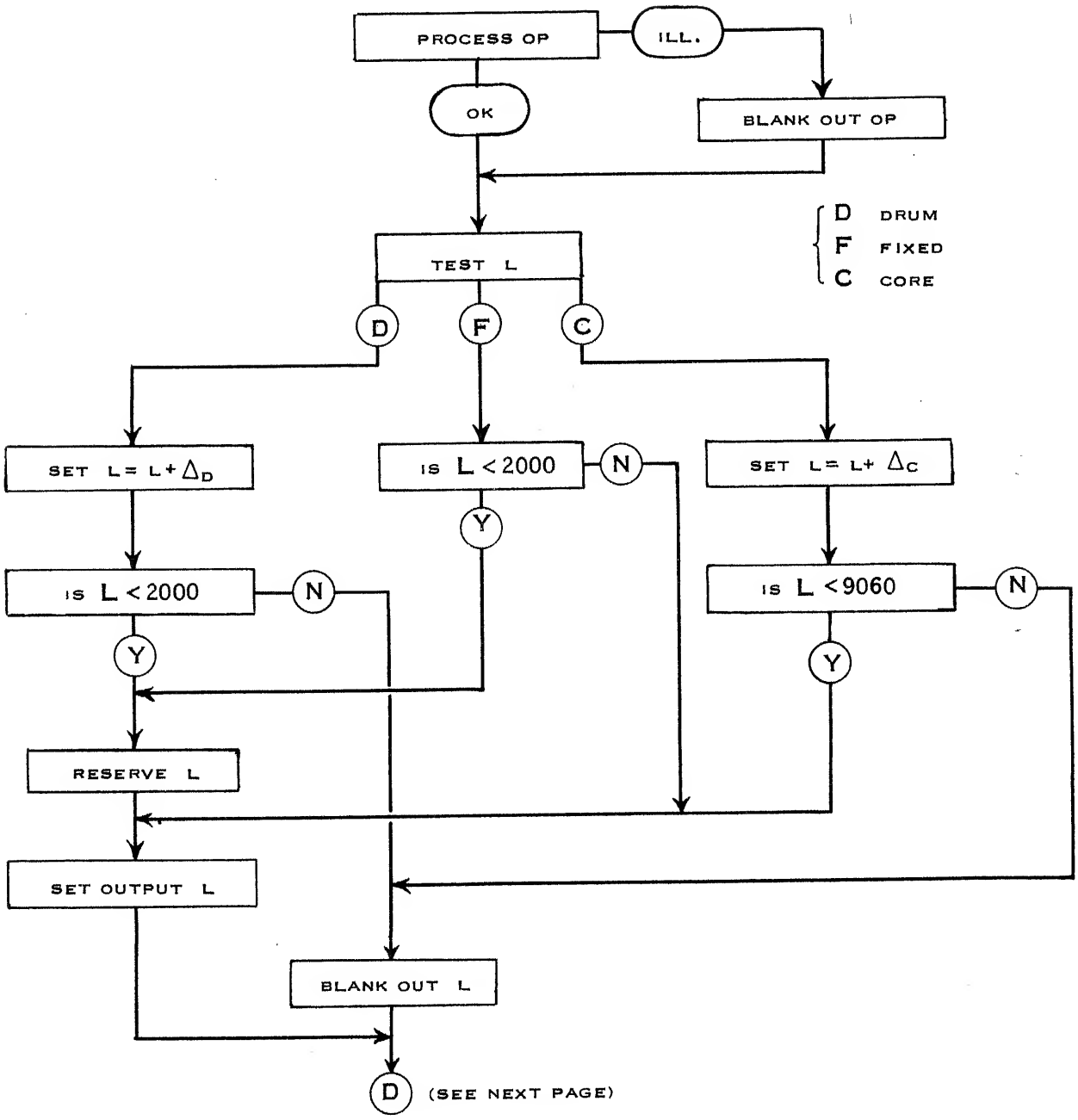
PSEUDO—OPERATION FLOW CHARTS



NOTE: EXCEPT FOR PAT, THESE ROUTINES TERMINATE AT "PUNCH"

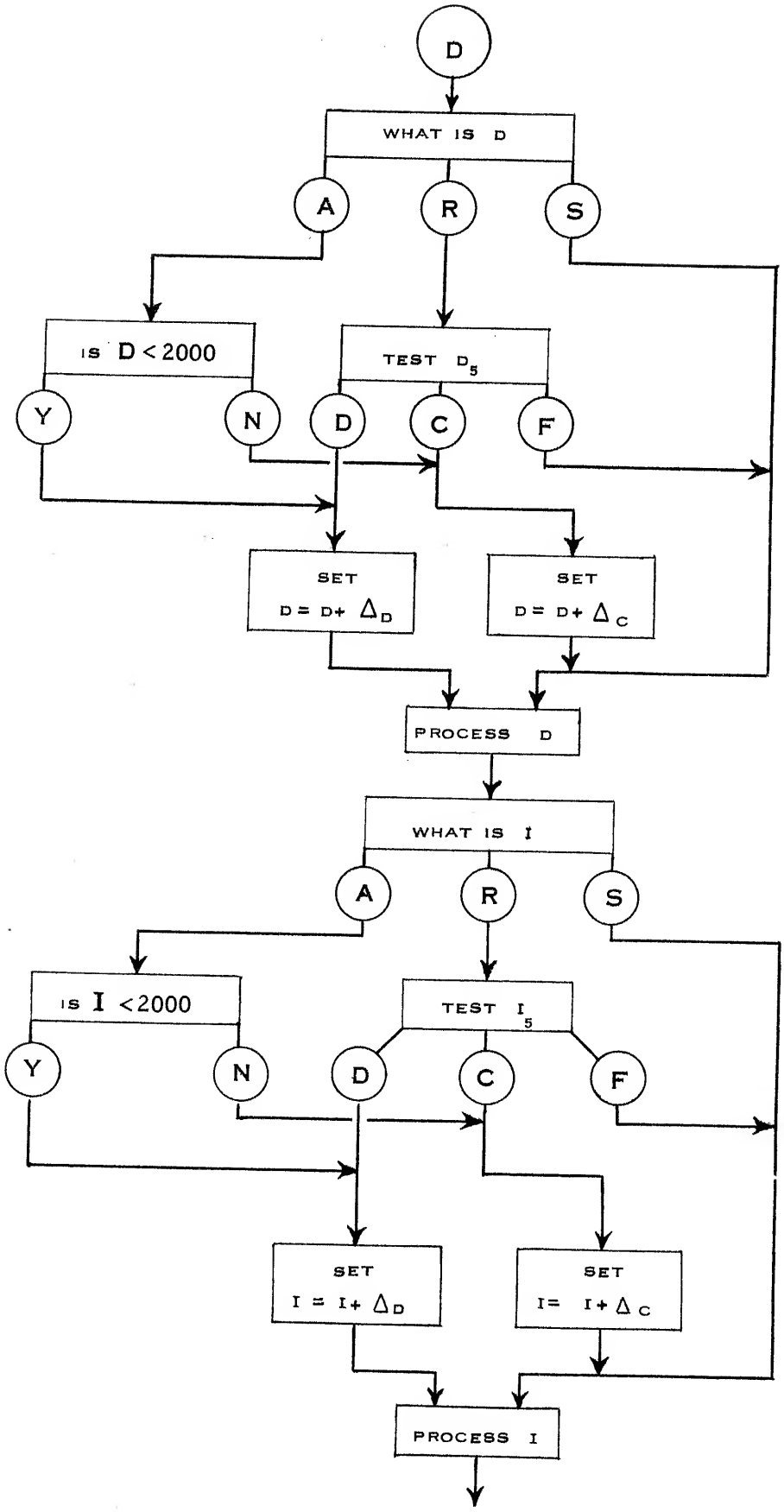

REG
EQU
SYN
SET TAG = 8
SET TAG = 8
SET TAG = 9
A = ABSOLUTE
R = REGIONAL
S = SYMBOLIC
WHAT IS I
A
R
S
SET E = ABS. ADR.
IS REGION DEFINED
N
Y
TEST SYMBOL
IN
NOT IN
FULL
TEST (I—2000)
−
+
SET E = I + Δ D
SET E = I + Δ C
CALCULATE REGIONAL ADDRESS
SET E = EQUIV.
SET E = REG. ADR.
TEST SYMBOLIC D
IN
NOT IN
FULL
RBR
RESERVE (FWA + Δ D) − (LWA + Δ D)
STORE D ≈ E
SET BYPAS
TEST TAG
8
9
RESERVE E

RELOCATABLE ROUTINE



L MAY BE 1) |F ⋮ NNNN| FIXED DRUM OR CORE

2) | ⋮ NNNN| RELOCATABLE DRUM OR CORE



(D_5 = SYMBOLIZER PART OF D)

Subroutines

SOAP II contains twenty-one subroutines. The following is a description of each subroutine giving

A. Functional description
B. Entry conditions and entry point
C. Exit conditions (where applicable)
D. Flow chart (where applicable)

1. Store K in all locations from FWA to LWA

Entry: UA (K)
LA(00, FWA, LWA)
DIST (exit)

Go to SUBR1

2. Reserve or unreserve N sequential drum locations beginning at FWA.

Entry: UA (00, 0000, FWA)
LA (00, 0000, N-1)
DIST (exit)

Go to { SUB2R - Reserve
SUB2U - Unreserve

3. Process op code and exit to K or (K + 1).

Entry: DIST (00, 0000, K)

Go to SUBR3

Exit: K: 1. Legal 650 op; numerical op stored in punch word 7 and optimizing table entry stored in "OPTIM."
2. Illegal symbolic op; "OPTIM" set to (5505050999) and punch control word set to blank out assembled op.

K + 1: Pseudo op (routine begins in 10XX)
UA (00, 0000, 10XX)
LA (irrelevant)

4. Determine whether address is absolute, regional or symbolic and accordingly exit to K, (K + 1), or (K + 2).

Entry: UA (alpha. address)
LA (clear)
DIST (00, 0000, K)

Go to SUBR4

Exit:
K: Absolute
K + 1: Regional
K + 2: Symbolic

} UA (alpha.address)
LA (clear)

Note: If address is symbolic, it is automatically headed and stored in "HSYMB." Upon exiting, the UA also contains the headed symbol.

5. Test absolute address A and exit to K, (K + 1), (K + 2) or (K + 3).

Entry: UA (irrelevant)
LA (00, 0000, A)
DIST (00, 0000, K)

Go to SUBR5

Exit:			
K:	A < 2000	}	UA (clear)
K + 1:	A = 800X		LA (00, 0000, A)
K + 2:	9000 ≦ A ≦ 9059		
K + 3:	Other		

6. Test symbol and exit to K, K + 1, or K + 2.

Entry: UA (symbol)
LA (clear)
DIST (00, 0000, K)

Go to SUBR6

Exit:			
K:	In table	}	UA (symbol)
	Equivalent in I address part of "EQUIV"		LA (00, L*, 0000)
			"LSYMB" (00, L*, 0000)
K+1:	Not in table		
K+2	Not in table and symbol table packed.		

Note: L* = symbol table location containing symbol on exit K or location in symbol table where symbol may be stored on exit (K + 1).

7. Store symbol in symbol table L* location and equivalent E in equivalence table.

Entry: UA (symbol)
LA (00, L*, E)
DIST (exit)

Go to SUBR7

8. Obtain equivalent E of symbol stored in symbol table location L*.

Entry: UA (clear)
LA (XX, L*, XXXX)
DIST (exit)

Go to SUBR8

Exit: UA (clear)
LA (00, L*, 0000)
"EQUIV" (00, 0000, E)

9. Calculate regional address A and exit to K or (K + 1).

Entry: UA (alpha. regional address) — Go to SUBR9
LA (clear)
DIST (00, 00 $\alpha\beta$, K); $\alpha\beta = \begin{cases} 90 - L \\ 88 - D \\ 89 - I \end{cases}$

Exit: K: UA (clear)
LA (00, 0000, A)
K + 1 : Region undefined or A negative.

10. Set "PUNCH A" 8 in punch control word and execute punch instruction.

Entry: UA (exit) — Go to SUB10
LA (clear)

11. Calculate optimum dynamic address and find and reserve "best" drum location L; exit to K or (K + 1).

Entry: UA (clear) — Go to SUB11
LA (00, 00 $\alpha\beta$, K): $\alpha\beta = \begin{cases} 90 - L \\ 88 - D \\ 89 - I \end{cases}$

Exit: K: UA (clear)
LA (00, 0000, L)
K + 1: Drum packed

12. Set 8 in punch control word to blank out assembled location.

Entry: UA (exit) — Go to SUB12
LA (clear)

13. Calculate optimum dynamic address XX.

Entry: DIST (00, 000 β , K) — Go to SUB13

$\beta = \begin{cases} 8 - D \\ 9 - I \end{cases}$

Exit: K: UA (clear)
LA (00, 0000, 00XX) $\quad 00 \leqq XX \leqq 49$

14. Punch availability table.

Entry: DIST (exit)

Go to SUB14

15. Head symbol.

Entry: UA (symbol)
LA (clear)
DIST (exit)

Go to SUB15

Exit: UA (headed symbol)
LA (clear)

16. Initialize assembly.

Entry: DIST (exit)

Go to SUB16

17. Calculate drum equivalent E of 800X

Entry: UA (exit)

Go to { SB17D - D equivalent
SB17I - I equivalent

Exit: UA (clear)
LA (00, 0000, E)

18. Index address A giving A*.

Entry: UA (irrelevant)
LA (00, 0000, A)
DIST (00, 00 $\alpha\beta$, K)

Go to INDEX

$$\alpha = \begin{cases} 8\text{-Drum} \\ 9\text{-Core} \end{cases}, \qquad \beta = \begin{cases} 8\text{-D} \\ 9\text{-I} \end{cases}$$

Exit: UA (irrelevant)
LA (00, 0000, A*)

19. Process location.

Entry: DIST (exit)

Go to PROCL

20. Process data address.

Entry: DIST (exit)

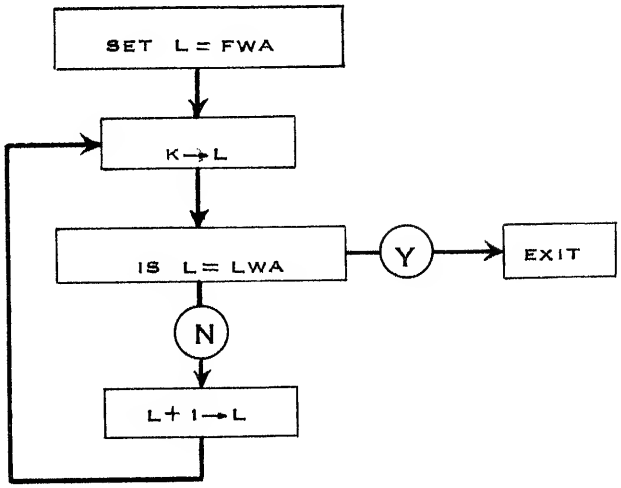
Go to PROCD

21. Process Instruction address.

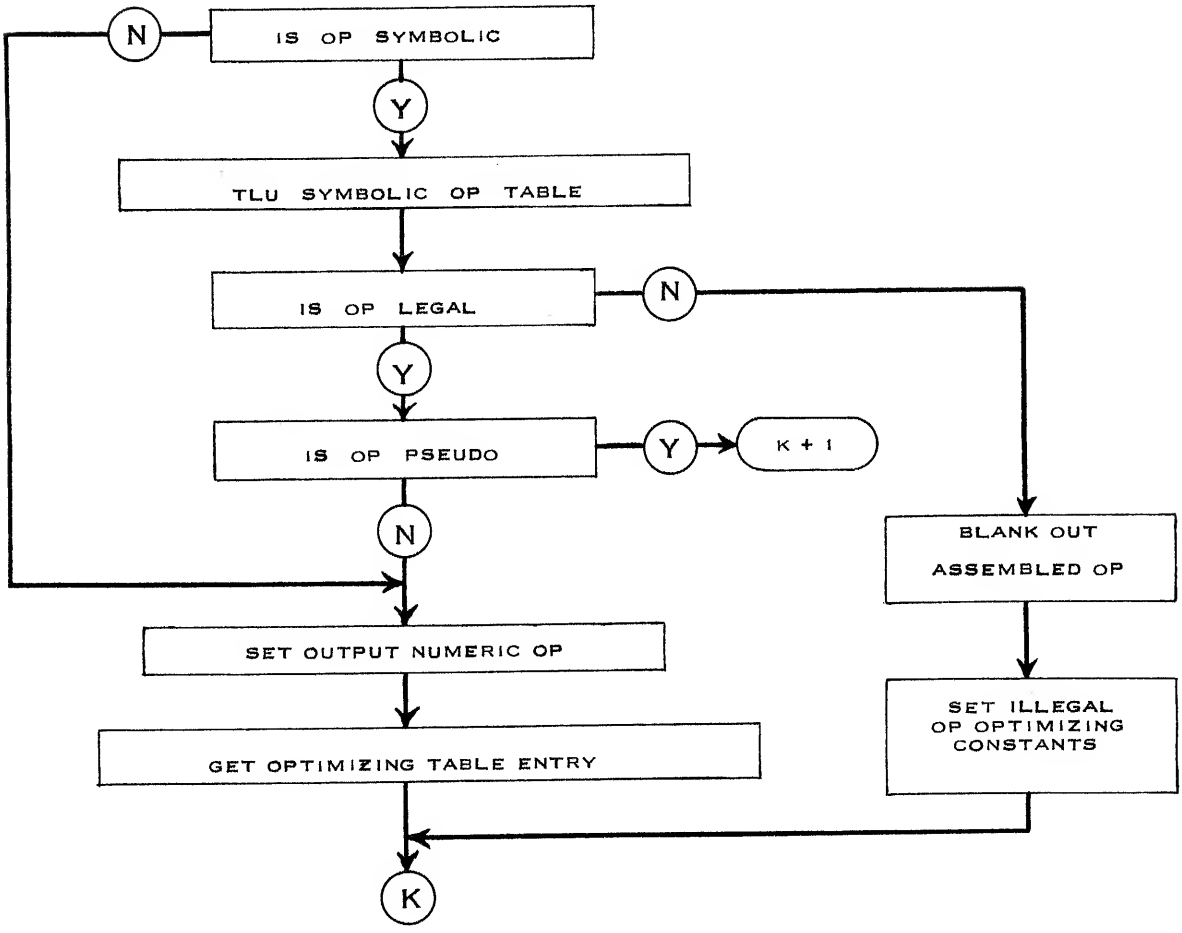
Entry: DIST (exit)

Go to PROCI

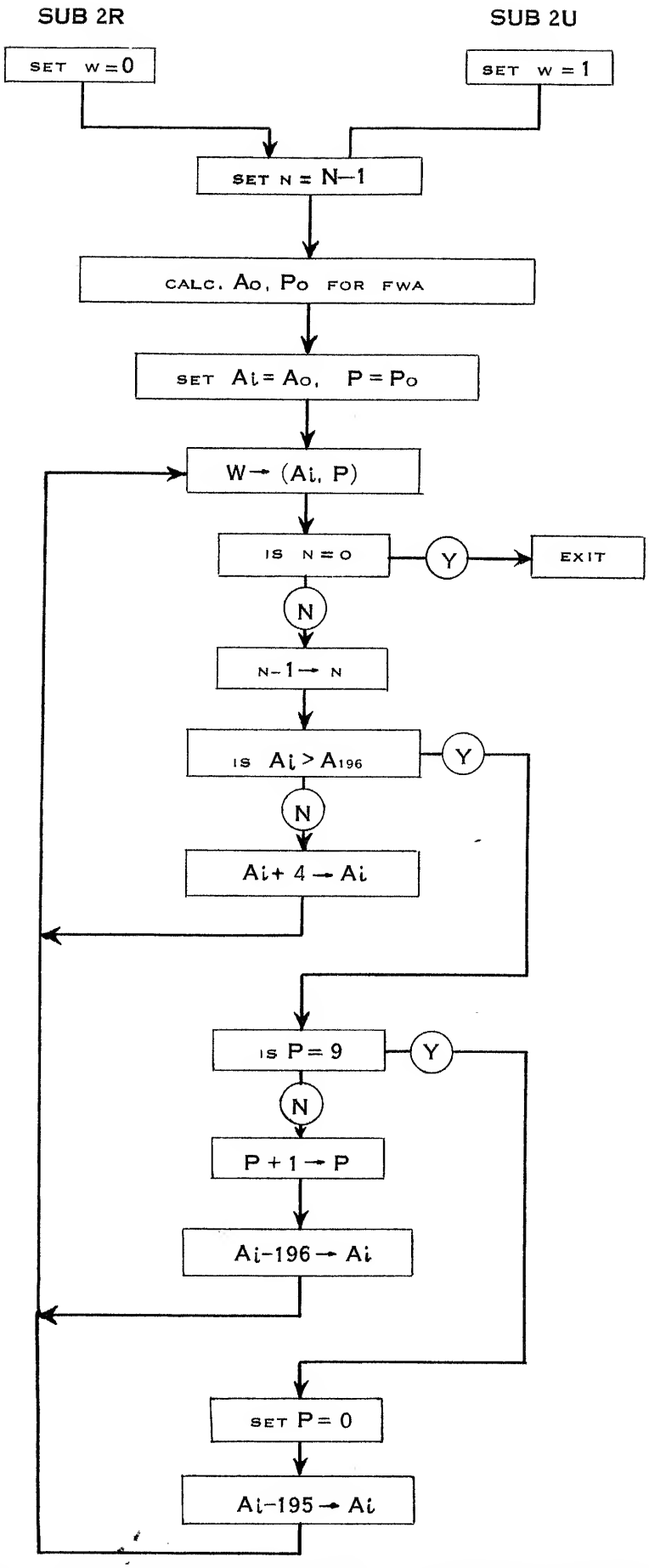
SUBROUTINE FLOW CHARTS



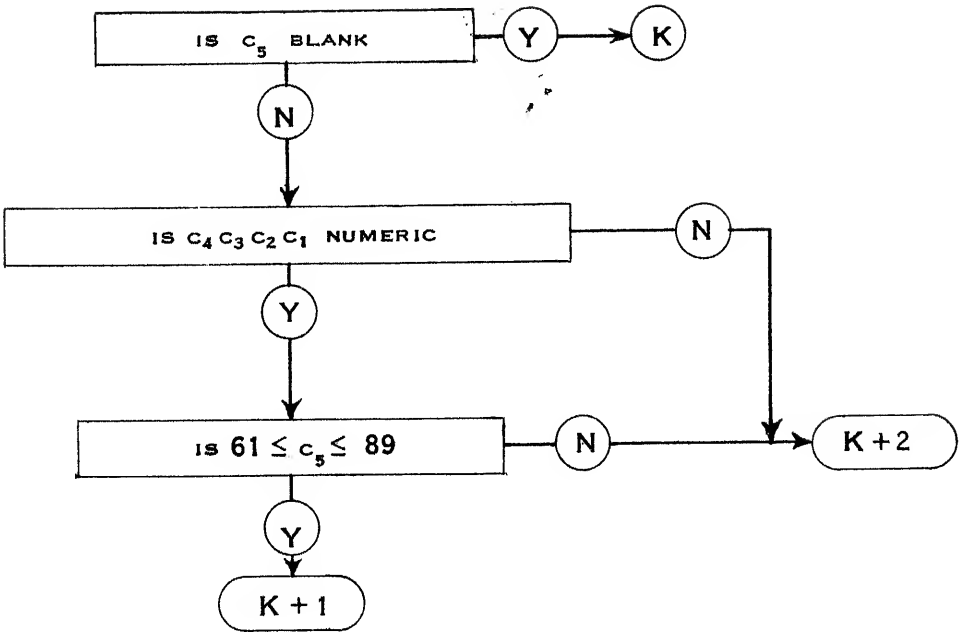
SUBROUTINE 1; STORE K IN FWA – LWA



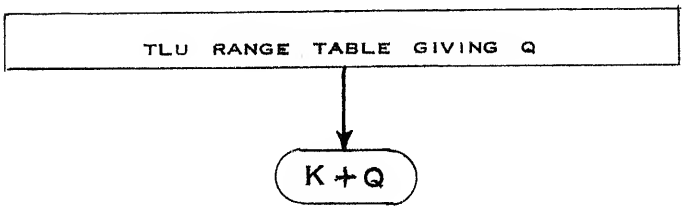
SUBROUTINE 3: PROCESS OP CODE



SUBROUTINE 2: RESERVE OR UNRESERVE N WORDS STARTING AT FWA

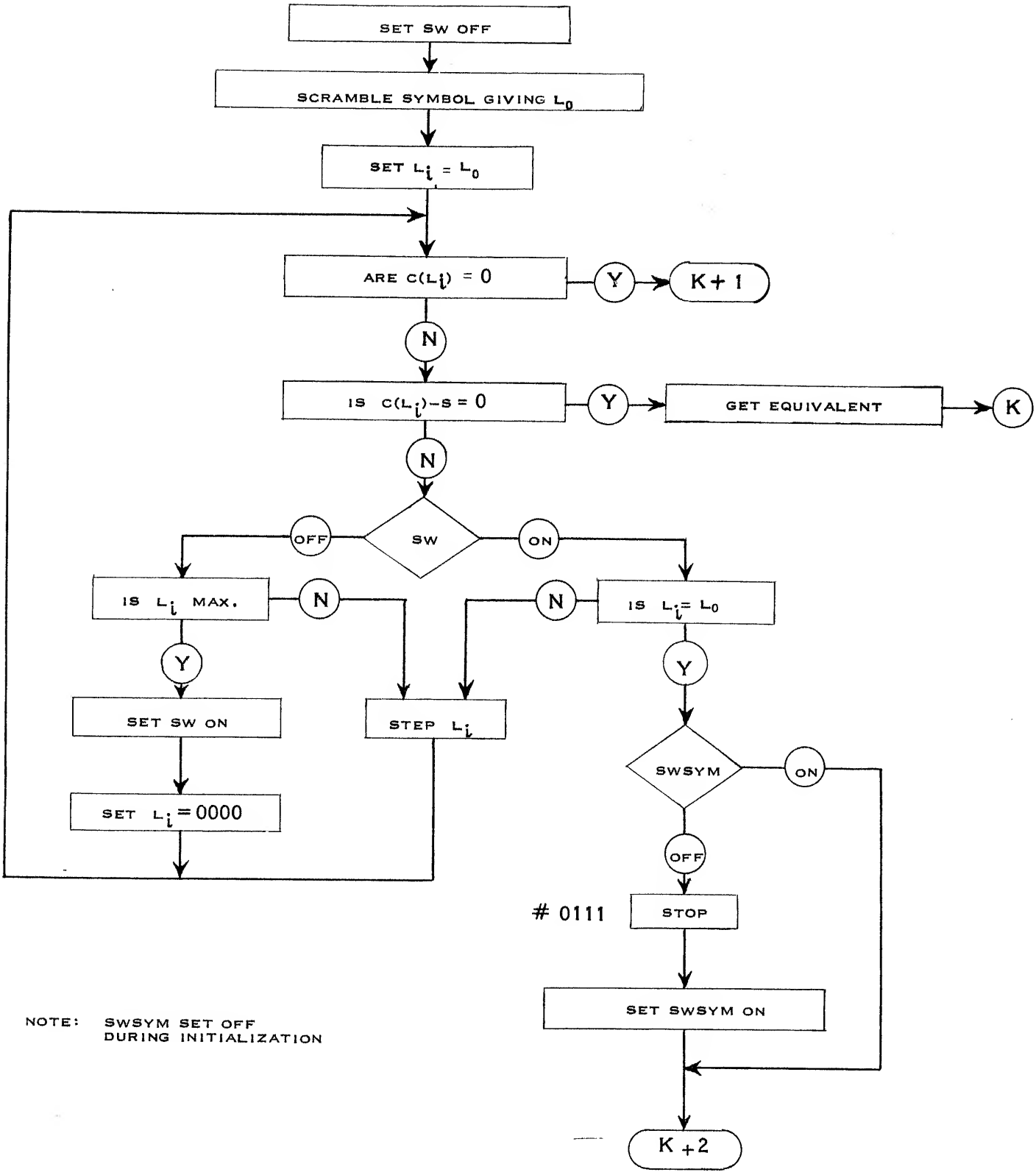


SUBROUTINE 4 : ADDRESS TEST

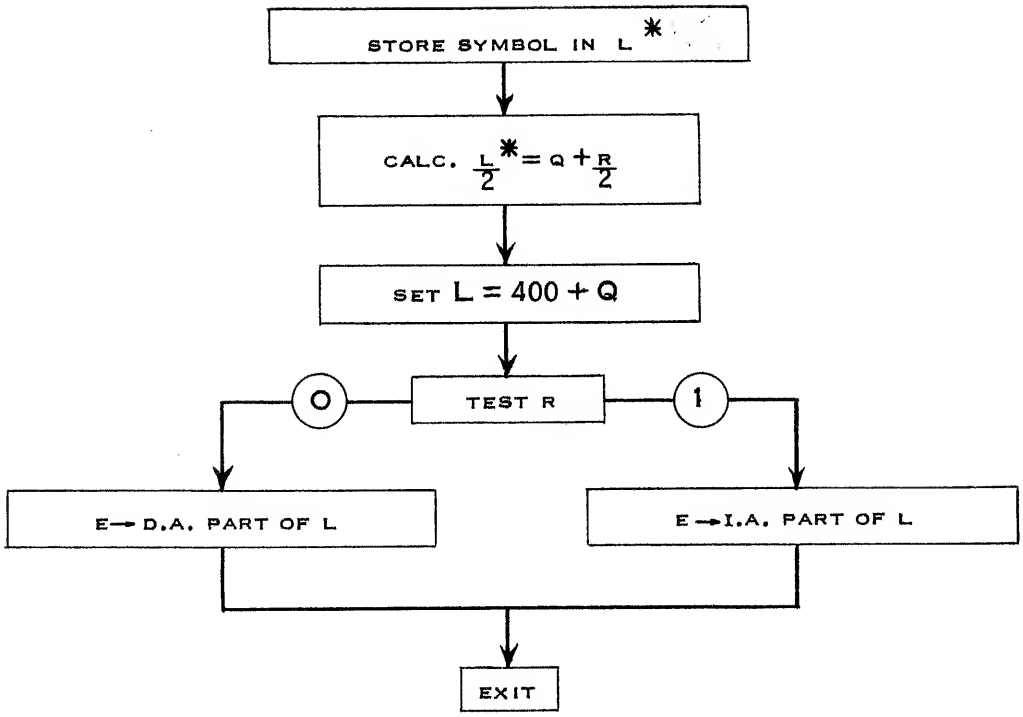


Q	RANGE
0	$0000 \leq A \leq 1999$
1	$8000 \leq A \leq 8003$
	$8005 \leq A \leq 8007$
2	$9000 \leq A \leq 9059$
3	OTHER

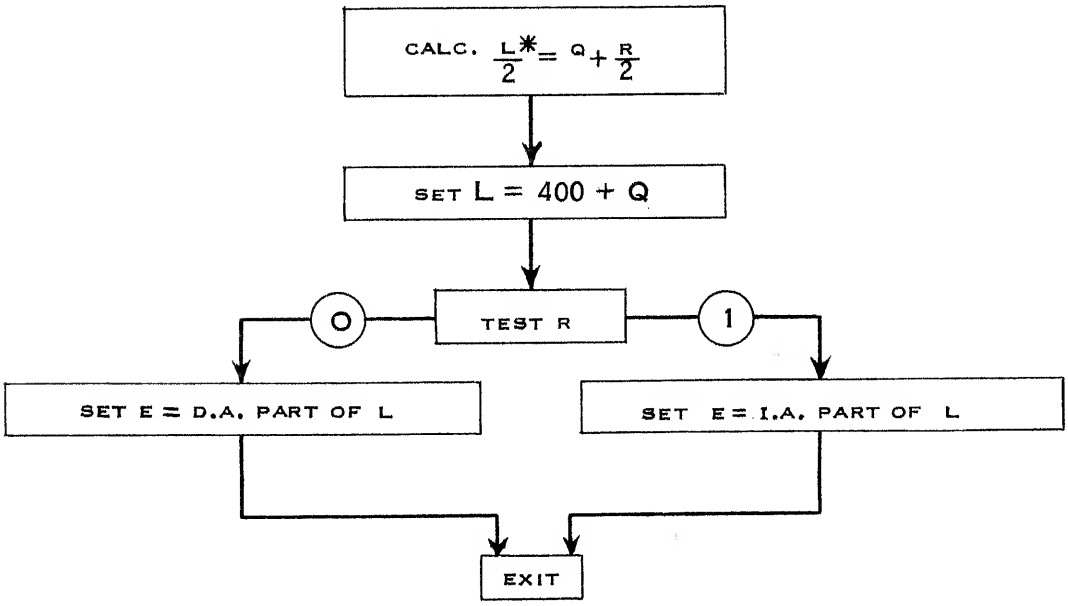
SUBROUTINE 5 : ADDRESS RANGE TEST



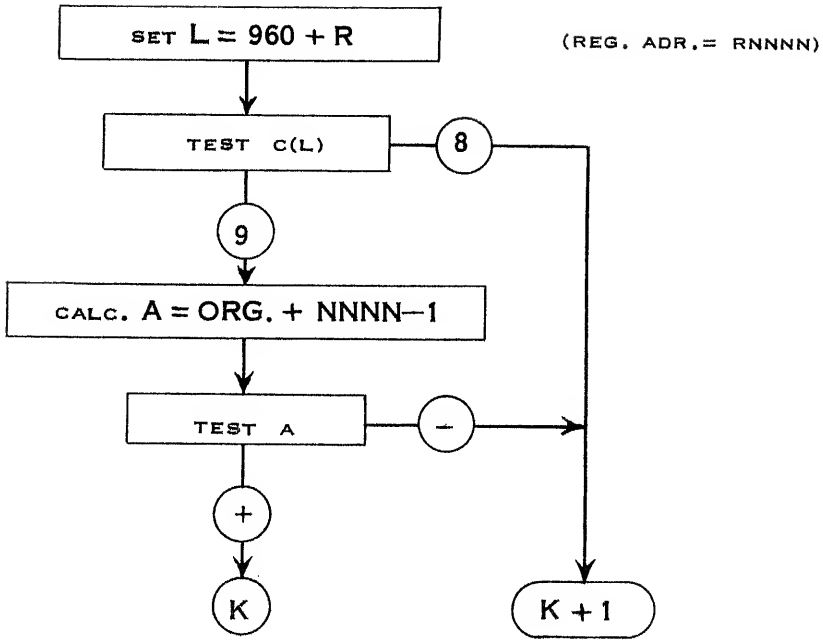
SUBROUTINE 6 : SYMBOL TEST



SUBROUTINE 7: STORE SYMBOL AND EQUIVALENT



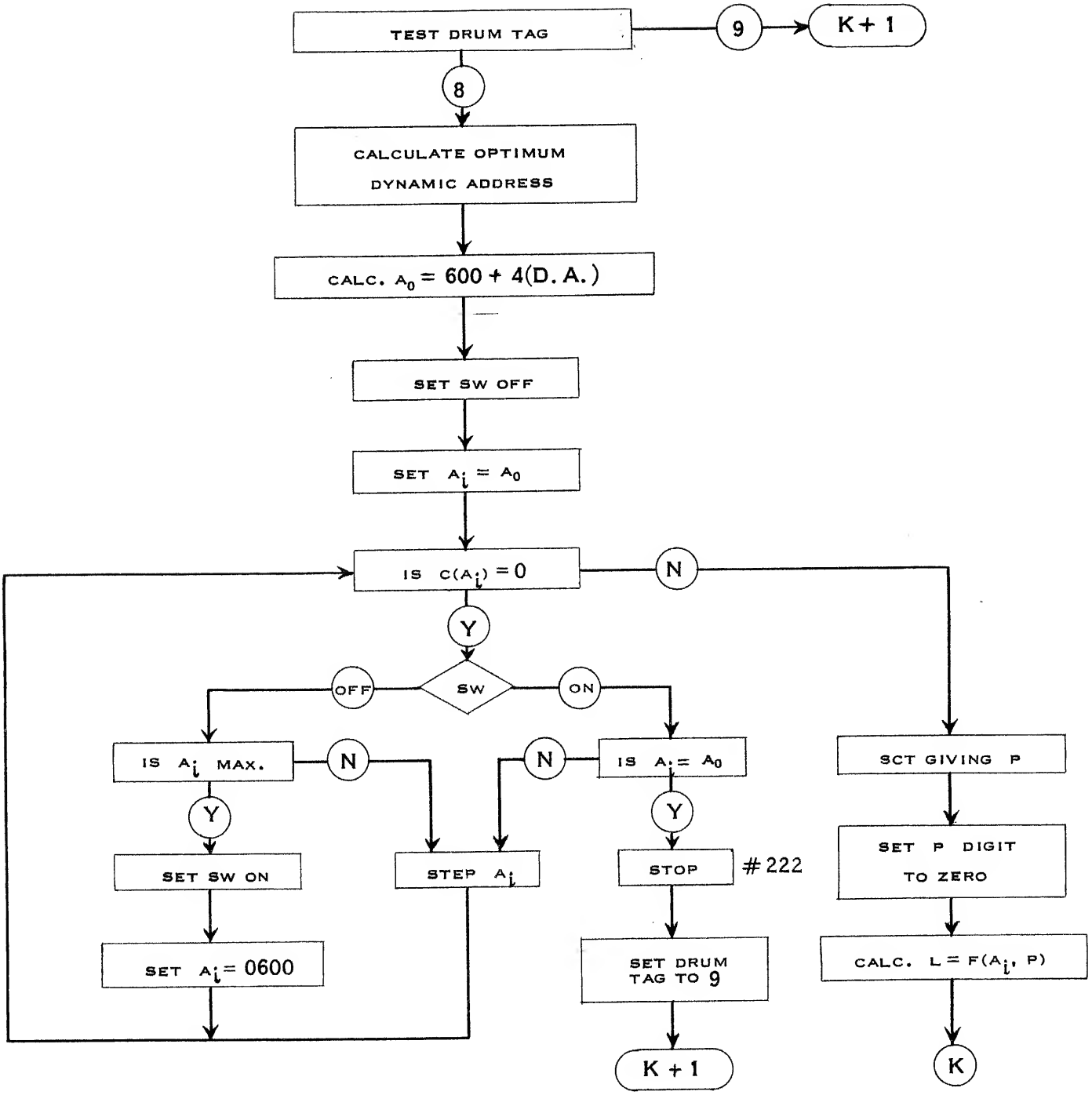
SUBROUTINE 8: OBTAIN SYMBOLIC EQUIVALENT



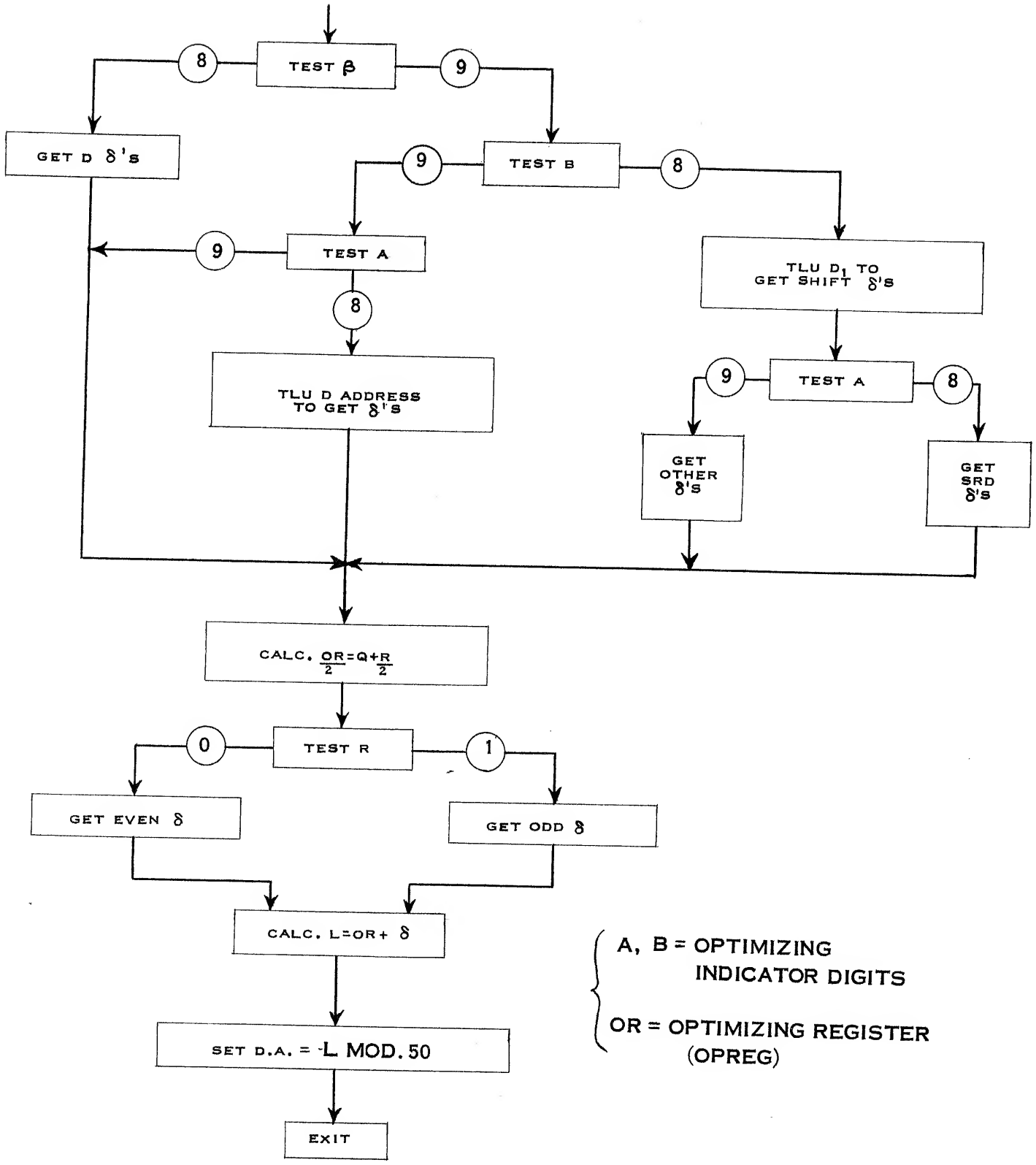
SUBROUTINE 9 : CALCULATE REGIONAL ADDRESS

SUBROUTINE 10 : (SEE PROGRAM LISTING)

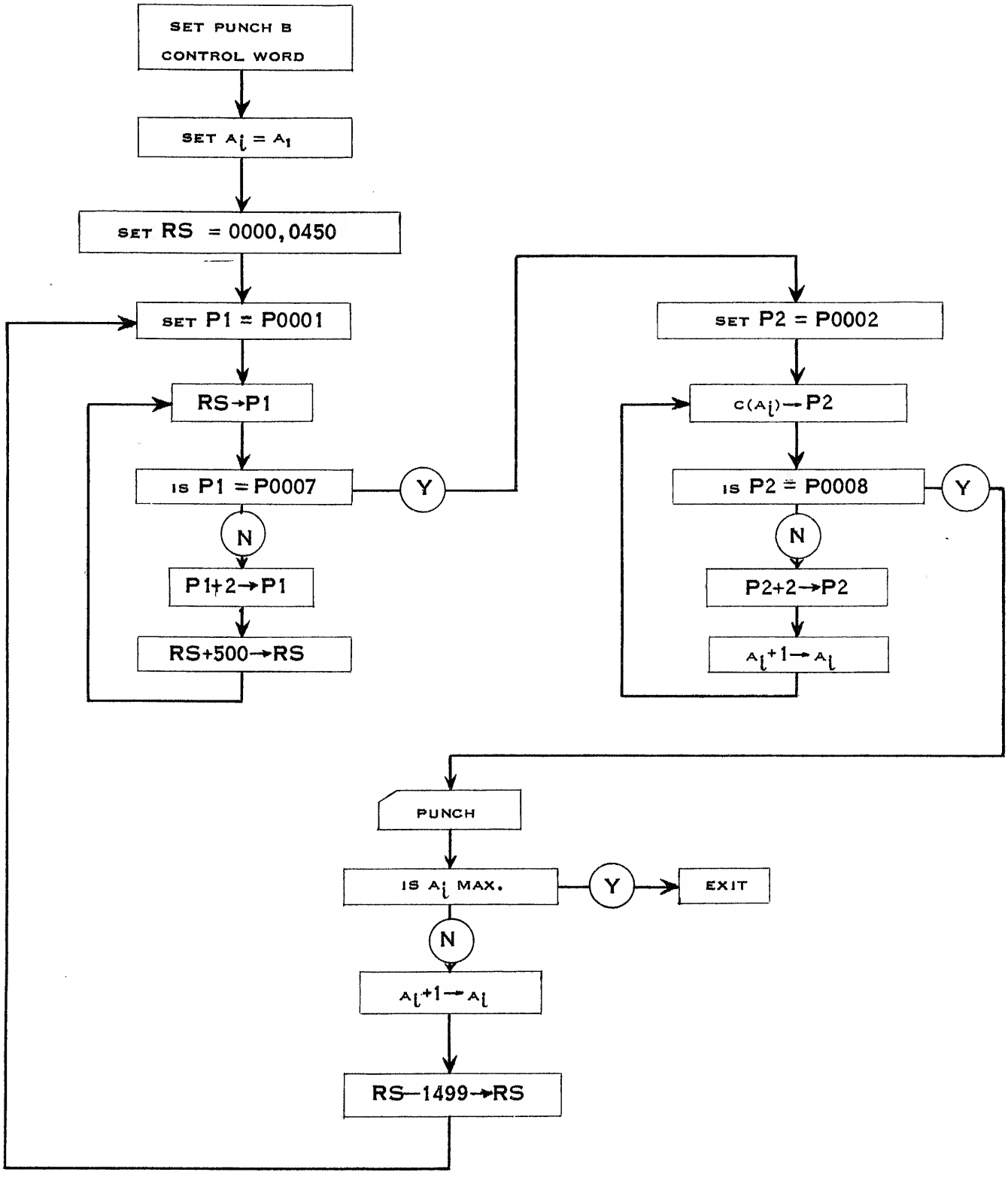
SUBROUTINE 12 : (SEE PROGRAM LISTING)



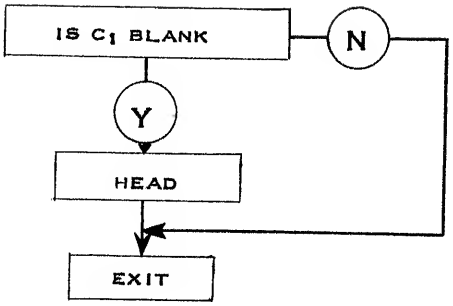
SUBROUTINE 11 : FIND AND RESERVE BEST DRUM LOCATION



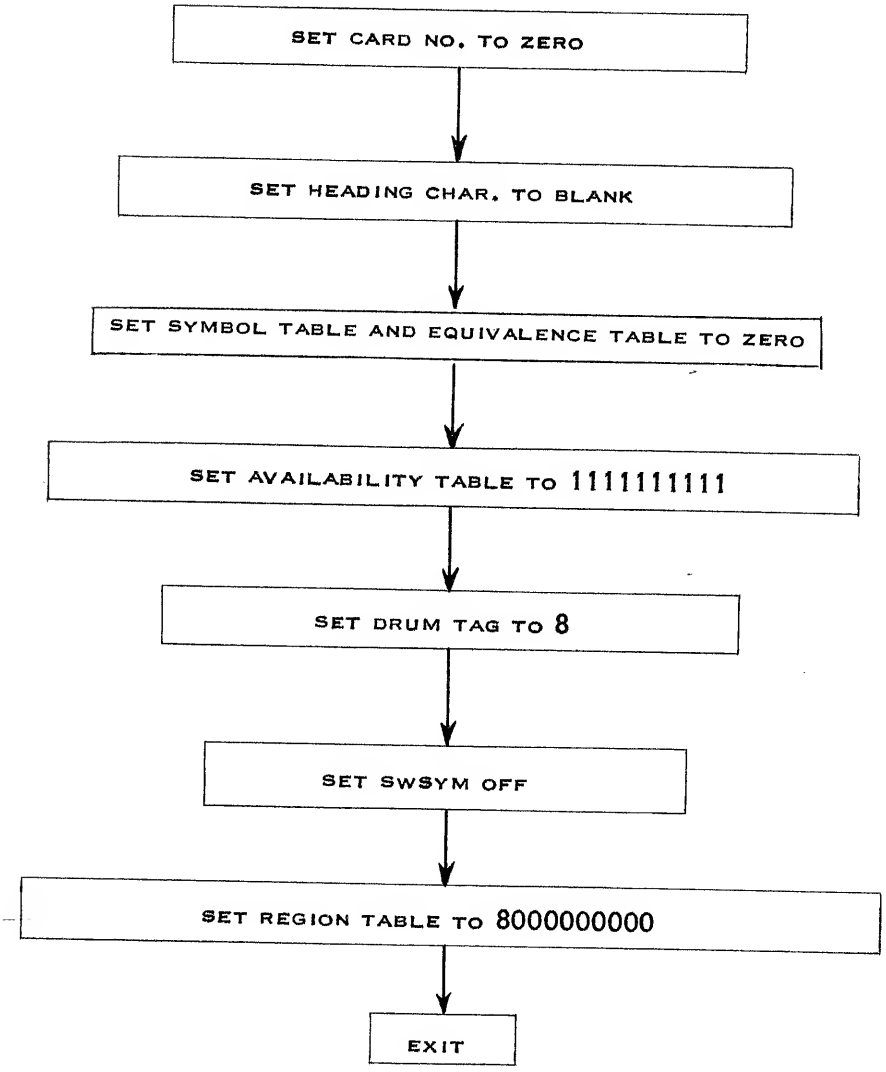
SUBROUTINE 13 : CALCULATE OPTIMUM DYNAMIC ADDRESS



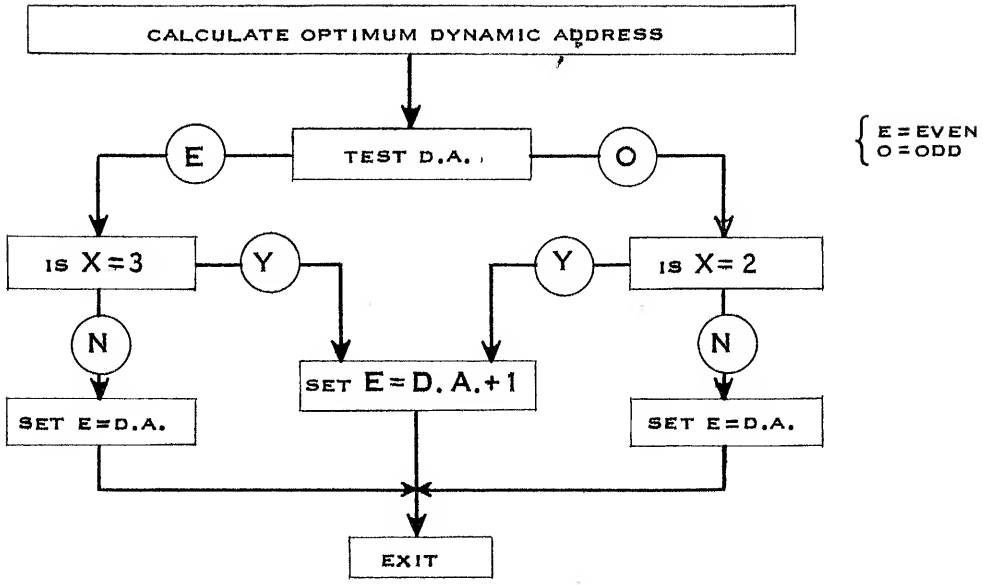
SUBROUTINE 14: PUNCH AVAILABILITY TABLE



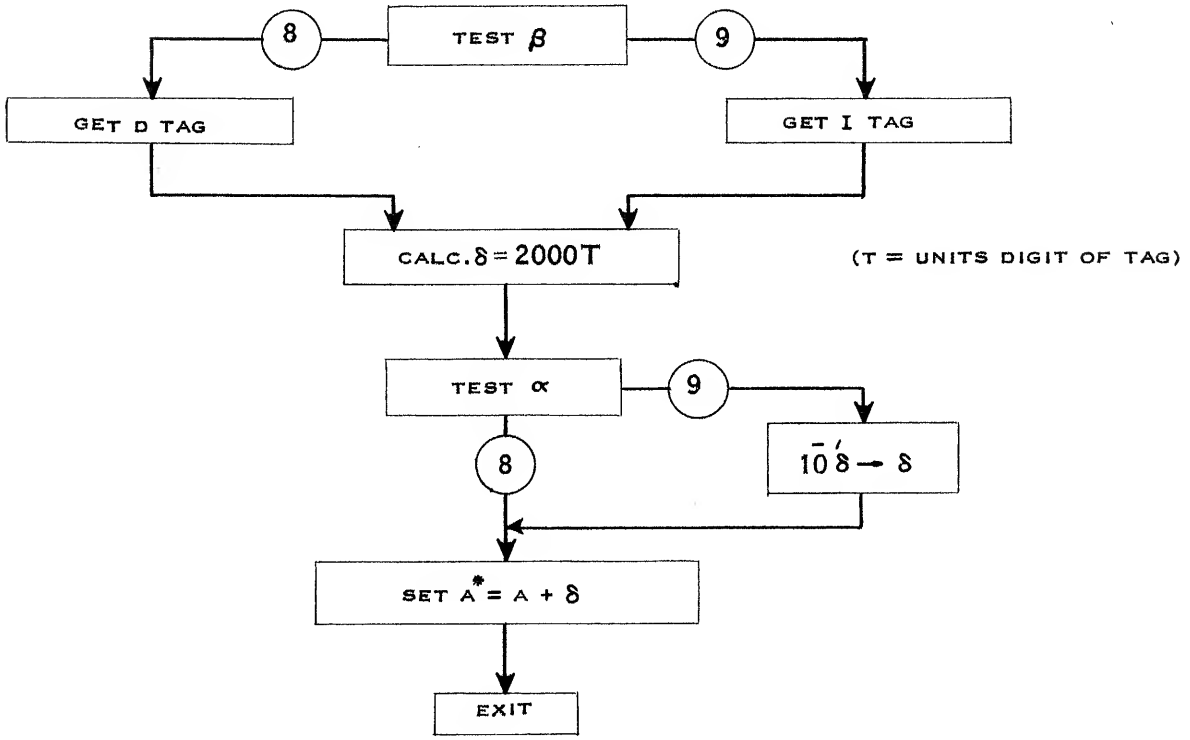
SUBROUTINE 15: HEADING



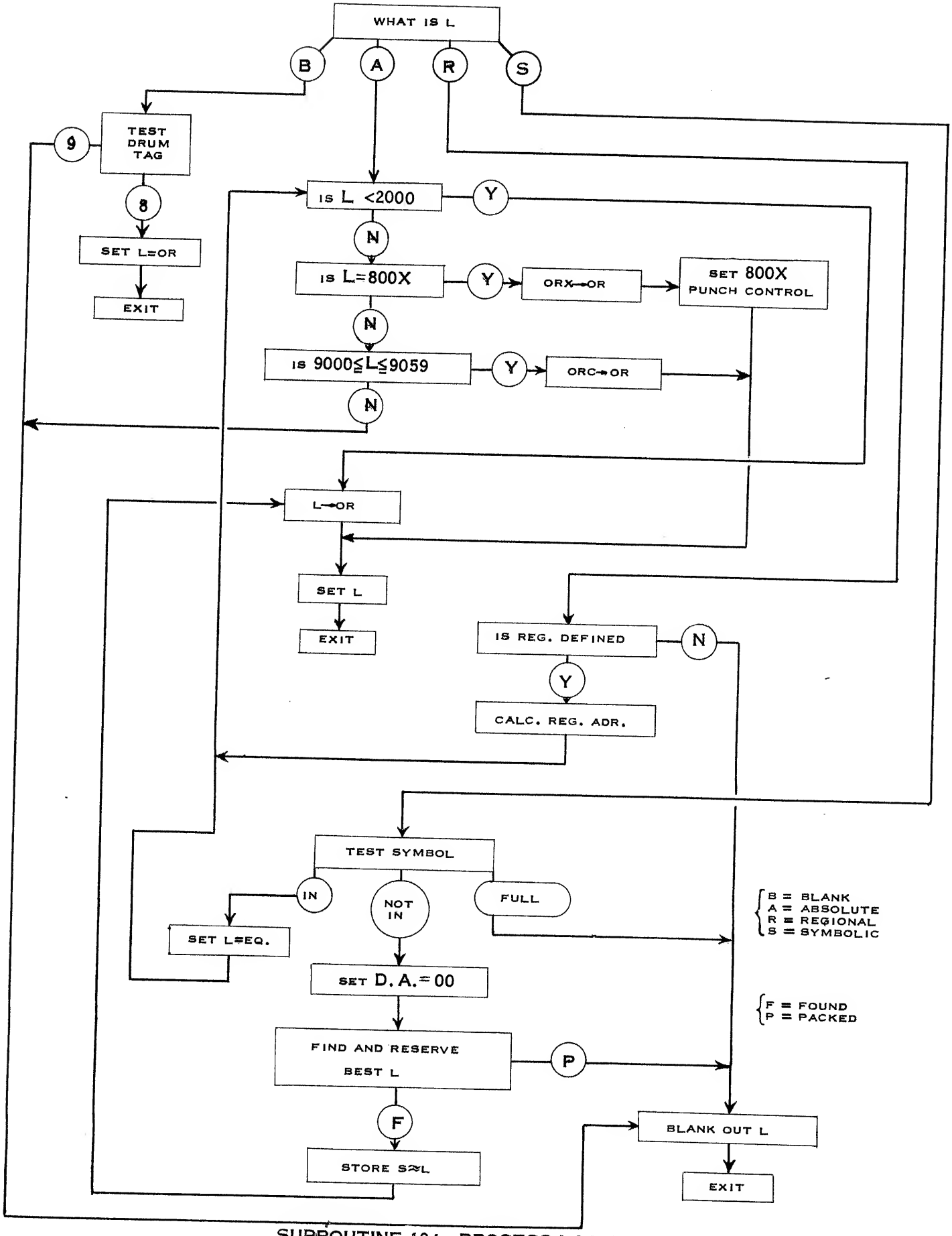
SUBROUTINE 16: INITIALIZATION



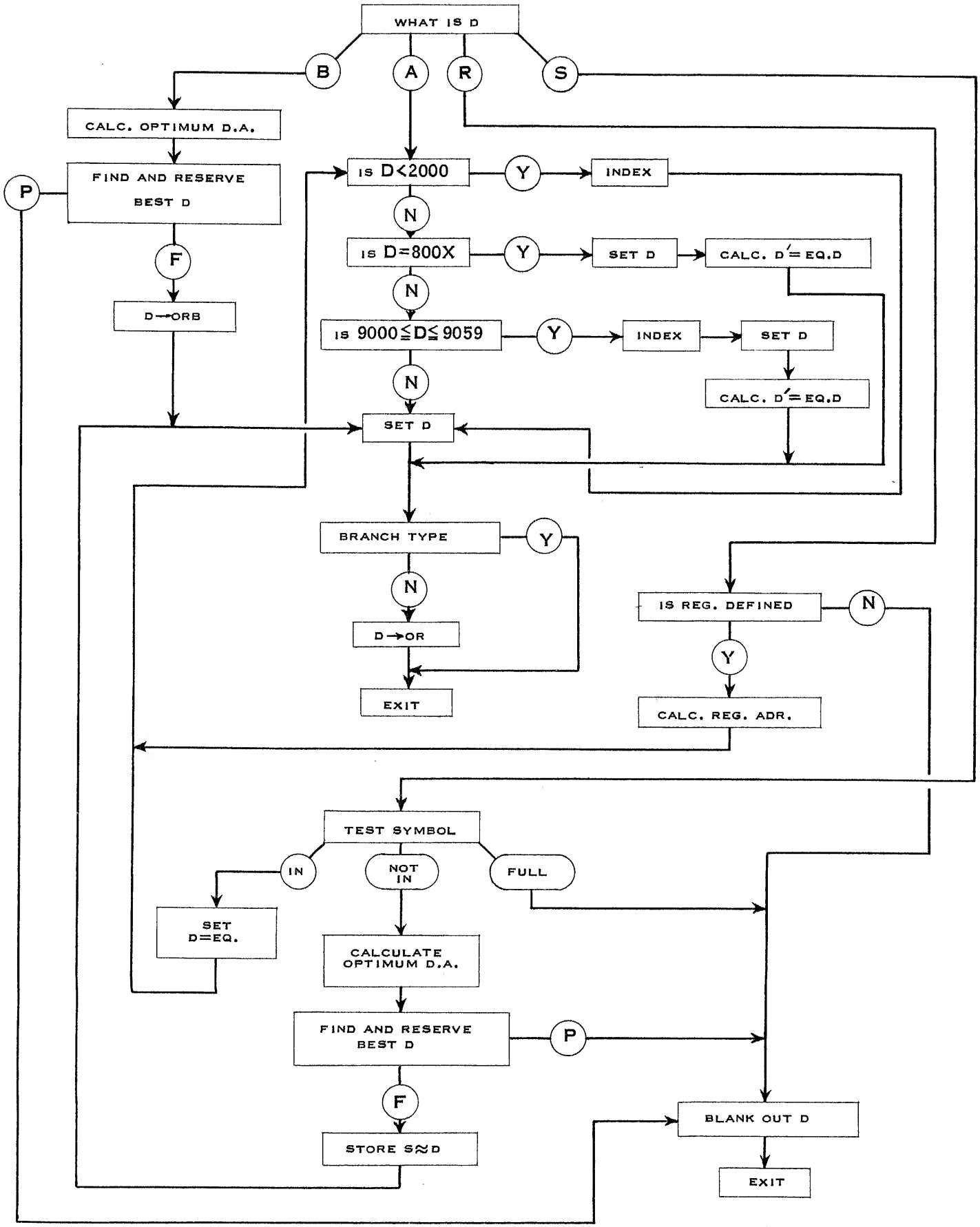
SUBROUTINE 17: CALCULATE 800X DRUM EQUIVALENT



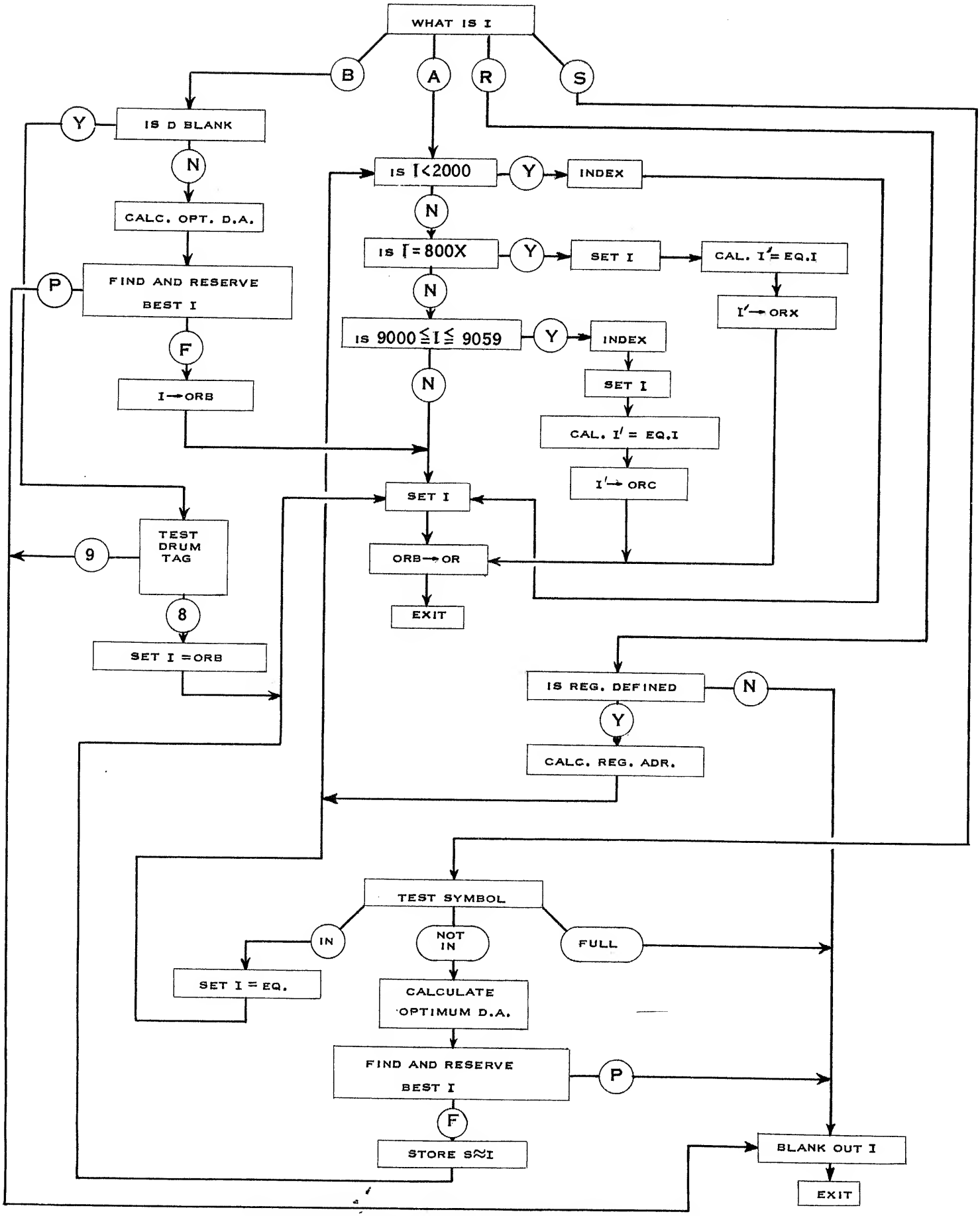
SUBROUTINE 18: INDEX ADDRESS



SUBROUTINE 19: PROCESS LOCATION



SUBROUTINE 20: PROCESS DATA ADDRESS



SUBROUTINE 21: PROCESS INSTRUCTION ADDRESS

SOAP 2

SYMBOLIC OPTIMAL ASSEMBLY PROG

FOR THE

IBM 650

DATA PROCESSING SYSTEM

```
REG   S0000   0399    SYMBOL TAB
REG   E0400   0599    EQUIV TABL
REG   A0600   0799    AVAIL TABL
REG   N0800   0899    NUM OP TAB
BLR    1000   1000    ENTRY
BLR    1001   1012    PSEUDO ENT
BLR    1021   1049    REG TABLE
REG   C1050   1164    SYM OP TAB
BLA    1098   1099
BLA    1148   1149
BLR    1900   1900    MANUAL PAT
SYN   READC  1950
BLR    1951   1962    READ AREA
REG   T1990   1992    TYPE
REG   P1977   1986    PUNCH AREA
BLR    1998   1999
EQU   XXXX1  1961
EQU   XXXX2  1962
BLR    1563   1570    TYPE2
BLA    1565   1565
BLA    1569   1569
REG   B0900   0901    SUB 2
REG   H0902   0904    TYPE 2
REG   M0905   0907
REG   Q0908   0909
REG   R1200   1207    SUB 5
REG   U1250   1259    SUB 13
REG   V0910   0912    EQU SYN
REG   X0913   0914    TYPE 0
REG   Y0915   0916    EQU SYN
REG   Z0917   0919
REG   W0920   0922
BLR    0923   0968    MULTIPLE R
REG   I1300   1307    SUB 13
```

CONTROL PROGRAM

```
1000    LDD   READC  SUB16   ENTRY          1000   69  1950  1353

READC   RCD    1999   1998   READ CARD      1950   70  1999  1998
1998    LDD    1951          TRANSFER       1998   69  1951  1354
        STD   P0001          ALPHABETIC     1354   24  1977  0980
        LDD    1952          INPUT          0980   69  1952  1355
        STD   P0002          TO             1355   24  1978  0981
```

```
                LDD     1953
                STD     P0003
                LDD     1954
                STD     P0004
                LDD     1955
                STD     P0005
                LDD     1956
                STD     P0006
                RAL     P0009
                ALO     1IXXX
                STL     P0009
                RAU     1960
                SRT     0002
                STU     P0008
                AUP     TORG
                STL     P0010     8003
8003            NOP      0000     9999

PUNCH           PCH     P0001     READC

SETCC           RAU     READC     SUB10

1900            LDD     READC     SUB14

T0001           LDD     X         SUBR3

X0001           LDD               PROCL
                LDD               PROCD
                LDD     PUNCH     PROCI

X0002           NOP      0000      8003

T0002           RAU     READC     SUB10

X               00       0000     X0001

                      RELOCATE ROUTINE

                HED     T
T0003           LDD     Q         SUBR3
Q0002           NOP      0000     ILLOP
Q0001           RAL      1951
                SLT      0002
                NZU               REL
                RAU      1957
                SUP     2000I
                BMI               FC
                AUP      8001     RES
FC              RAL      1957     SETL
SR              RAL     XXXX1     SETL
SETL            SLT      0004
                LDD     P0008
                SDA     P0008     PROD
```

```
OUTPUT          0981    69    1953    1356
                1356    24    1979    0982
                0982    69    1954    1357
                1357    24    1980    0983
                0983    69    1955    1208
                1208    24    1981    0984
                0984    69    1956    1209
                1209    24    1982    0985
STEP            0985    65    1985    0989
CARD            0989    15    0992    0997
NUMBER          0997    20    1985    0988
STORE           0988    60    1960    1015
CONTROL         1015    30    0002    0971
INFO            0971    21    1984    0987
                0987    10    0990    0995
TRANSFER        0995    20    1986    8003
TO TYPE         8003    00    0000    9999

PUNCH READ      1350    71    1977    1950

SUDO EXIT       1400    60    1950    1405

MANUAL PAT      1900    69    1950    1403

TYPE 0          1990    69    0993    0996

650             0913    69    1016    0969
COMMAND OR      1016    69    1019    0972
CONSTANTS       1019    69    1350    1453

PSEUDO OP       0914    00    0000    8003

TYPE 1 COM      1991    60    1950    1405

                0993    00    0000    0913

PROCESS OP      1992    69    1195    0996
ILLEGAL OP      0909    00    0000    1013
IS L FIXED      0908    65    1951    1455
                1455    35    0002    1211
                1211    44    1165    1166
FIXED L         1165    60    1957    1261
DRUM CORE       1261    11    1014    1169
                1169    46    1172    0973
FIXED DRUM      1172    10    8001    0979
FIXED CORE      0973    65    1957    1311
SET L           1450    65    1961    1311
                1311    35    0004    1171
                1171    69    1984    1187
                1187    22    1984    1237
```

```
REL     RAU    1957
        SUP    2000I
        BMI            RC
        AUP    DDIFF
        BMI            BL
        AUP    2000I   RES
RES     STU    XXXX1
        LDD    SR      SUB2R
RC      RAL    1957
        ALO    CDIFF
        SLO    9060
        BMI            BL
        ALO    8001    SETL
BL      RAU    PROD    SUB12

        REG    J0944    0944
        REG    G0941    0941

PROD    LDD    PROI
        STD    EXITX
        RAU    1952
        LDD    H       SUBR4
H0001   RAL    1958
        SLO    2000I
        BMI    1564     1563
H0002   SRT    0008
        AUP    1500     8003
 1563   RAL    CDIFF   CDD
 1564   RAL    DDIFF   CDD
 1566   RAL    1958    J0001
CDD     ALO    1958    J0001
H0003   NOP    0000    G0003

        REG    J0960    0960
        REG    F0955    0955

PROI    LDD    PUNCH
        STD    EXITX
        RAU    1953
        LDD    M       SUBR4
M0001   RAL    1959
        SLO    2000I
        BMI    1568     1567
M0002   SRT    0008
        AUP    1504     8003
 1567   RAL    CDIFF   CDI
 1568   RAL    DDIFF   CDI
 1570   RAL    1959    J0001
CDI     ALO    1959    J0001
M0003   NOP    0000    F0003

Q         00   0000    Q0001
9060      00   0000     9060
H         00   0000    H0001
1500      00   0000     1500
```

```
DRUM CORE       1166   60   1957   1361
                1361   11   1014   1219
                1219   46   1222   1173
RELOCATE        1222   10   0975   1179
DRUM ADDR       1179   46   1182   1183
                1182   10   1014   0979
                0979   21   1961   1214
RESERVE L       1214   69   1450   1503
RELOCATE        1173   65   1957   1411
CORE            1411   15   1264   1269
                1269   16   1272   0977
                0977   46   1180   1183
                1180   15   8001   1311
BLANK L         1183   60   1237   0991

D TYPE 2

SET D EXIT      1237   69   1190   1193
                1193   24   1196.  0999
WHAT IS D       0999   60   1952   1407
                1407   69   1210   1213
RELOCATE        0902   65   1958   1263
D OR C          1263   16   1014   1319
                1319   46   1564   1563
C D OR F        0903   30   0008   1221
                1221   10   0974   8003
C               1563   65   1264   1369
D               1564   65   0975   1369
F               1566   65   1958   0944
                1369   15   1958   0944
SYMBOLIC        0904   00   0000   0943

I

SET I EXIT      1190   69   1350   1553
                1553   24   1196   1099
WHAT IS I       1099   60   1953   1457
                1457   69   1260   1213
RELOCATE        0905   65   1959   1313
D OR C          1313   16   1014   1419
                1419   46   1568   1567
C D OR F        0906   30   0008   1175
                1175   10   0978   8003
C               1567   65   1264   1469
D               1568   65   0975   1469
F               1570   65   1959   0960
                1469   15   1959   0960
SYMBOLIC        0907   00   0000   0957

CONSTANTS       1195   00   0000   0908
                1272   00   0000   9060
                1210   00   0000   0902
                0974   00   0000   1500
```

```
M          00    0000   M0001                          1260   00   0000   0905
1504       00    0000    1504                          0978   00   0000   1504
XXXX1      01    0000   XXXX1     ERASEABLE            1961   01   0000   1961
           HED
```

BOP ROUTINE

```
1001       LDD                    SUB16     INITIALIZE   1001   69   1404   1353
           RAU      READC         SUB10     PUNCH        1404   60   1950   1405
```

BLR ROUTINE

```
1002       RAL      1959          BLR       RESERVE      1002   65   1959   1363
BLR        SLO      1958                    FWA TO       1363   16   1958   1413
           AUP      8001                    LWA          1413   10   8001   1271
           LDD      SETCC         SUB2R                  1271   69   1400   1503
```

RBR ROUTINE

```
1012       RAU      DDIFF                                1012   60   0975   1229
           ALO       1959         BLR                   1229   15   1959   1363
```

BLA ROUTINE

```
1003       LDD      H8XXX         SET DRUM     1003   69   1406   1309
           STD      DRUMT         TAG TO 8     1309   24   1212   1215
           RAL       1959         UNRESERVE    1215   65   1959   1463
           SLO       1958         FWA          1463   16   1958   1513
           AUP       8001         TO           1513   10   8001   1321
           LDD      SETCC   SUB2U  LWA          1321   69   1400   1603
```

REG ROUTINE

```
           HED      R
1004       RAL       1952                      IS           1004   65   1952   1507
           SRT       0008                      REGION       1507   30   0008   1225
           SLO      90XXX                      CHARACTER    1225   16   1178   1233
           BMI                 1002            ALPHABETIC   1233   46   0986   1002
           ALO      29XXX                                   0986   15   1189   1243
           BMI       1002                                   1243   46   1002   1197
           SLT       0004                      STORE        1197   35   0004   1557
           ALO      ST                         REGION       1557   15   1310   1265
           AUP       1958                      ORIGIN       1265   10   1958   1613
           AUP      H9XXX          8002                     1613   10   1216   8002
8002       STU       9999          1002                     8002   21   9999   1002

ST         STU       1021          1002       CONSTANTS     1310   21   1021   1002
           HED
```

EQU REQ AND SYN ROUTINE

```
           HED      Z
1005       LDD      H8XXX   BOTH     EQU          1005   69   1406   1359
1006       LDD      H9XXX   BOTH     SYN          1006   69   1216   1359
BOTH       STD      TAG                           1359   24   1262   1315
```

```
         RAU    1953                WHAT IS I'     1315   60   1953   1607
         LDD    Z         SUBR4                    1607   69   1360   1213
Z0001    RAL    1959      Y0001     ABSOLUTE       0917   65   1959   0915
Z0002    LDD    Y         SUBR9     REGIONAL       0918   69   1371   1174
Y0001    STL    E         TD                       0915   20   1519   1322
Y0002    RAL    P0010     BP        REG ERROR      0916   65   1986   1191
Z0003    LDD    W         SUBR6     SYMBOLIC       0919   69   1372   1275
W0001    RAL    EQUIV     Y0001     S DEFINED      0920   65   1223   0915
W0002    RAL    P0010     BP        S UNDEFIND     0921   65   1986   1191
W0003    RAL    P0010     BP        S TAB FULL     0922   65   1986   1191

TD       RAU    1952                HEAD D         1322   60   1952   1657
         LDD              SUB15     AND EQUATE     1657   69   1410   1663
         LDD    V         SUBR6     TO E           1410   69   1713   1275
V0003    RAL    P0010     BP        S TAB FULL     0912   65   1986   1191
V0001    ALO    E         SD                       0910   15   1519   1273
V0002    ALO    E         SD                       0911   15   1519   1273
SD       LDD    TT        SUBR7                    1273   69   0976   1279

TT       LDD    TAG                 TEST TAG       0976   69   1262   1365
         BDO    SETCC                              1365   90   1400   0970
         RAU    E                   RESERVE E      0970   60   1519   1323
         LDD    SETCC     SUB2R                    1323   69   1400   1503

 1011    LDD    H8XXX               REQ            1011   69   1406   1409
         STD    TAG                 ROUTINE        1409   24   1262   1415
         RAL    1959                IS I           1415   65   1959   1763
         SLO    2000I               DRUM O COR     1763   16   1014   1569
         BMI    D                                  1569   46   1422   1373
         ALO    CDIFF     CD                       1373   15   1264   1619
D        ALO    DDIFF     CD                       1422   15   0975   1619
CD       ALO    2000I     Y0001                    1619   15   1014   0915

Z        00     0000      Z0001     CONSTANTS      1360   00   0000   0917
Y        00     0089      Y0001                    1371   00   0089   0915
W        00     0000      W0001                    1372   00   0000   0920
V        00     0000      V0001                    1713   00   0000   0910
88       00     8800       0000                    1500   00   8800   0000

BP       ALO    88                  BY PASS        1191   15   1500   1505
         STL    P0010     PUNCH                    1505   20   1986   1350

TAG      01     0000      TAG       ERASEABLE      1262   01   0000   1262
E        01     0000      E                        1519   01   0000   1519
         HED

                ALF ROUTINE

 1007    LDD              PROCL     PROCES LOC     1007   69   1460   0969
         LDD    1952                               1460   69   1952   1555
         STD    P0007                              1555   24   1983   1186
         RAL    1953                REPLACE        1186   65   1953   1707
         NZE    PUNCH               BLANK I        1707   45   1350   1461
         LDD    SOAP2               BY             1461   69   1314   1017
         STD    P0003     PUNCH     SOAP2          1017   24   1979   1350
```

```
SOAP2     ALF     SOAP2     SOAP2      CONSTANT      1314    82    7661    7792

                  PAT ROUTINE

 1008     RAU                 SUB10                  1008    60    1511    1405
          LDD      READC      SUB14                  1511    69    1950    1403

                  HED ROUTINE

 1009     RAL       1952                STORE         1009    65    1952    1757
          SRT       0008                HEADING       1757    30    0008    1325
          STL       0000H     SETCC     CHARACTER     1325    20    1329    1400

                  REL ROUTINE

          HED       M
 1010     RAL       1952                SET           1010    65    1952    1807
          NZE                 SDD       DRUM          1807    45    1510    1561
          RAL       1958      SDD       AND           1510    65    1958    1561
 SDD      STL       DDIFF               CORE          1561    20    0975    1228
          RAL       1953                DELTAS        1228    65    1953    1857
          NZE                 SCD                     1857    45    1560    1611
          RAL       1959      SCD                     1560    65    1959    1611
 SCD      STL       CDIFF     SETCC                   1611    20    1264    1400

 DDIFF     01       0000      DDIFF     ERASEABLE     0975    01    0000    0975
 CDIFF     01       0000      CDIFF                   1264    01    0000    1264
          HED

                  LOAD AVAILABILITY TABLE

          HED       L
 1999     RAL       1951                CALC          1999    65    1951    1605
          SRT       0004                LOC           1605    30    0004    1465
          SLT       0004                W2            1465    35    0004    1375
          ALO       8002                              1375    15    8002    1283
          ALO       8002                              1283    15    8002    1241
          ALO       C1                                1241    15    0994    1149
          AUP       C2        8003                    1149    10    1352    8003
 8003     LDD       9995      8002      LOAD          8003    69    9995    8002
 8002     STD       9994      TUP       TABLE         8002    24    9994    1247
 TUP      SUP       TW                                1247    11    1550    1655
          NZU                 READC                   1655    44    1459    1950
          AUP       TWP2                              1459    10    1312    1167
          ALO       1DXXX     8003                    1167    15    1020    8003

 C1       STD       A0001     TUP       CONSTANTS     0994    24    0600    1247
 C2       LDD       1952      8002                    1352    69    1952    8002
 TW       LDD       1958      8002                    1550    69    1958    8002
 TWP2     LDD       1960      8002                    1312    69    1960    8002
          HED
```

OPTIMIZING TABLE

N0001	00	0404	0998	NOP	0800	00	0404	0998
N0002	00	0404	0998	HLT	0801	00	0404	0998
N0003	33	2322	0999	UFA	0802	33	2322	0999
N0004	00	0505	0998	RTC	0803	00	0505	0998
N0005	00	0505	0998	RTN	0804	00	0505	0998
N0006	00	0505	0998	RTA	0805	00	0505	0998
N0007	00	0505	0998	WTN	0806	00	0505	0998
N0008	00	0505	0998	WTA	0807	00	0505	0998
N0009	33	1212	0999	LIB	0808	33	1212	0999
N0010	33	0202	0999	LDI	0809	33	0202	0999
N0011	33	0504	0999	AUP	0810	33	0504	0999
N0012	33	0504	0999	SUP	0811	33	0504	0999
N0013	99	9999	9999	NOT USED	0812	99	9999	9999
N0014	99	9999	9999	NOT USED	0813	99	9999	9999
N0015	33	1110	0999	DIV	0814	33	1110	0999
N0016	33	0504	0999	ALO	0815	33	0504	0999
N0017	33	0504	0999	SLO	0816	33	0504	0999
N0018	33	0504	0999	AML	0817	33	0504	0999
N0019	33	0504	0999	SML	0818	33	0504	0999
N0020	33	2120	0999	MPY	0819	33	2120	0999
N0021	54	0303	0999	STL	0820	54	0303	0999
N0022	45	0303	0999	STU	0821	45	0303	0999
N0023	34	0303	0999	SDA	0822	34	0303	0999
N0024	34	0303	0999	SIA	0823	34	0303	0999
N0025	33	0303	0999	STD	0824	33	0303	0999
N0026	44	0505	0998	NTS	0825	44	0505	0998
N0027	00	0505	0998	BIN	0826	00	0505	0998
N0028	00	0505	0998	SET	0827	00	0505	0998
N0029	33	1212	0999	SIB	0828	33	1212	0999
N0030	33	0202	0999	STI	0829	33	0202	0999
N0031	00	0000	0988	SRT	0830	00	0000	0988
N0032	00	0000	0888	SRD	0831	00	0000	0888
N0033	33	2726	0999	FAD	0832	33	2726	0999
N0034	33	2726	0999	FSB	0833	33	2726	0999
N0035	33	0000	0999	FDV	0834	33	0000	0999
N0036	00	0000	0988	SLT	0835	00	0000	0988
N0037	00	0000	0988	SCT	0836	00	0000	0988
N0038	33	2726	0999	FAM	0837	33	2726	0999
N0039	33	2726	0999	FSM	0838	33	2726	0999
N0040	33	0000	0999	FMP	0839	33	0000	0999
N0041	33	0404	0998	NZA	0840	33	0404	0998
N0042	33	0404	0998	BMA	0841	33	0404	0998
N0043	33	0404	0998	NZB	0842	33	0404	0998
N0044	33	0404	0998	BMB	0843	33	0404	0998
N0045	34	0405	0998	NZU	0844	34	0405	0998
N0046	43	0504	0998	NZE	0845	43	0504	0998
N0047	33	0404	0998	BMI	0846	33	0404	0998
N0048	33	0505	0998	BOV	0847	33	0505	0998
N0049	33	0404	0998	NZC	0848	33	0404	0998
N0050	33	0404	0998	BMC	0849	33	0404	0998
N0051	00	0000	0898	AXA	0850	00	0000	0898
N0052	00	0000	0898	SXA	0851	00	0000	0898
N0053	00	0000	0898	AXB	0852	00	0000	0898

N0054	00	0000	0898	SXB	0853	00	0000	0898
N0055	44	0505	0998	NEF	0854	44	0505	0998
N0056	00	0505	0998	RWD	0855	00	0505	0998
N0057	00	0505	0998	WTM	0856	00	0505	0998
N0058	00	0505	0998	BST	0857	00	0505	0998
N0059	00	0000	0898	AXC	0858	00	0000	0898
N0060	00	0000	0898	SXC	0859	00	0000	0898
N0061	33	0504	0999	RAU	0860	33	0504	0999
N0062	33	0504	0999	RSU	0861	33	0504	0999
N0063	99	9999	9999	NOT USED	0862	99	9999	9999
N0064	99	9999	9999	NOT USED	0863	99	9999	9999
N0065	33	1110	0999	DVR	0864	33	1110	0999
N0066	33	0504	0999	RAL	0865	33	0504	0999
N0067	33	0504	0999	RSL	0866	33	0504	0999
N0068	33	0504	0999	RAM	0867	33	0504	0999
N0069	33	0504	0999	RSM	0868	33	0504	0999
N0070	33	0303	0999	LDD	0869	33	0303	0999
N0071	00	0000	0999	RD1	0870	00	0000	0999
N0072	00	0000	0999	WR1	0871	00	0000	0999
N0073	00	0000	0999	RC1	0872	00	0000	0999
N0074	00	0000	0999	RD2	0873	00	0000	0999
N0075	00	0000	0999	WR2	0874	00	0000	0999
N0076	00	0000	0999	RC2	0875	00	0000	0999
N0077	00	0000	0999	RD3	0876	00	0000	0999
N0078	00	0000	0999	WR3	0877	00	0000	0999
N0079	00	0000	0999	RC3	0878	00	0000	0999
N0080	00	0505	0999	RPY	0879	00	0505	0999
N0081	00	0000	0898	RAA	0880	00	0000	0898
N0082	00	0000	0898	RSA	0881	00	0000	0898
N0083	00	0000	0898	RAB	0882	00	0000	0898
N0084	00	0000	0898	RSB	0883	00	0000	0898
N0085	33	0506	0999	TLU	0884	33	0506	0999
N0086	00	0606	0998	SDS	0885	00	0606	0998
N0087	00	0606	0998	RDS	0886	00	0606	0998
N0088	00	0606	0998	WDS	0887	00	0606	0998
N0089	00	0000	0898	RAC	0888	00	0000	0898
N0090	00	0000	0898	RSC	0889	00	0000	0898
N0091	44	0505	0998	BD0	0890	44	0505	0998
N0092	33	0505	0998	BD1	0891	33	0505	0998
N0093	33	0505	0998	BD2	0892	33	0505	0998
N0094	33	0505	0998	BD3	0893	33	0505	0998
N0095	33	0505	0998	BD4	0894	33	0505	0998
N0096	33	0505	0998	BD5	0895	33	0505	0998
N0097	33	0505	0998	BD6	0896	33	0505	0998
N0098	33	0505	0998	BD7	0897	33	0505	0998
N0099	33	0505	0998	BD8	0898	33	0505	0998
N0100	44	0505	0998	BD9	0899	44	0505	0998

SYMBOLIC OP TABLE

C0001	61	7366	1007	ALF	1050	61	7366	1007
C0002	61	7376	0015	ALO	1051	61	7376	0015
C0003	61	7473	0017	AML	1052	61	7473	0017
C0004	61	8477	0010	AUP	1053	61	8477	0010
C0005	61	8761	0050	AXA	1054	61	8761	0050

C0006	61	8762	0052	AXB	1055	61	8762	0052
C0007	61	8763	0058	AXC	1056	61	8763	0058
C0008	62	6476	0090	BDO	1057	62	6476	0090
C0009	62	6491	0091	BD1	1058	62	6491	0091
C0010	62	6492	0092	BD2	1059	62	6492	0092
C0011	62	6493	0093	BD3	1060	62	6493	0093
C0012	62	6494	0094	BD4	1061	62	6494	0094
C0013	62	6495	0095	BD5	1062	62	6495	0095
C0014	62	6496	0096	BD6	1063	62	6496	0096
C0015	62	6497	0097	BD7	1064	62	6497	0097
C0016	62	6498	0098	BD8	1065	62	6498	0098
C0017	62	6499	0099	BD9	1066	62	6499	0099
C0018	62	6975	0026	BIN	1067	62	6975	0026
C0019	62	7361	1003	BLA	1068	62	7361	1003
C0020	62	7379	1002	BLR	1069	62	7379	1002
C0021	62	7461	0041	BMA	1070	62	7461	0041
C0022	62	7462	0043	BMB	1071	62	7462	0043
C0023	62	7463	0049	BMC	1072	62	7463	0049
C0024	62	7469	0046	BMI	1073	62	7469	0046
C0025	62	7677	1001	BOP	1074	62	7677	1001
C0026	62	7685	0047	BOV	1075	62	7685	0047
C0027	62	8283	0057	BST	1076	62	8283	0057
C0028	64	6985	0014	DIV	1077	64	6985	0014
C0029	64	8579	0064	DVR	1078	64	8579	0064
C0030	65	7884	1005	EQU	1079	65	7884	1005
C0031	66	6164	0032	FAD	1080	66	6164	0032
C0032	66	6174	0037	FAM	1081	66	6174	0037
C0033	66	6485	0034	FDV	1082	66	6485	0034
C0034	66	7477	0039	FMP	1083	66	7477	0039
C0035	66	8262	0033	FSB	1084	66	8262	0033
C0036	66	8274	0038	FSM	1085	66	8274	0038
C0037	68	6564	1009	HED	1086	68	6564	1009
C0038	68	7383	0001	HLT	1087	68	7383	0001
C0039	73	6464	0069	LDD	1088	73	6464	0069
C0040	73	6469	0009	LDI	1089	73	6469	0009
C0041	73	6962	0008	LIB	1090	73	6962	0008
C0042	74	7788	0019	MPY	1091	74	7788	0019
C0043	75	6566	0054	NEF	1092	75	6566	0054
C0044	75	7677	0000	NOP	1093	75	7677	0000
C0045	75	8382	0025	NTS	1094	75	8382	0025
C0046	75	8961	0040	NZA	1095	75	8961	0040
C0047	75	8962	0042	NZB	1096	75	8962	0042
C0048	75	8963	0048	NZC	1097	75	8963	0048
C0051	75	8965	0045	NZE	1100	75	8965	0045
C0052	75	8984	0044	NZU	1101	75	8984	0044
C0053	77	6183	1008	PAT	1102	77	6183	1008
C0054	77	6368	0071	PCH	1103	77	6368	0071
C0055	79	6161	0080	RAA	1104	79	6161	0080
C0056	79	6162	0082	RAB	1105	79	6162	0082
C0057	79	6163	0088	RAC	1106	79	6163	0088
C0058	79	6173	0065	RAL	1107	79	6173	0065
C0059	79	6174	0067	RAM	1108	79	6174	0067
C0060	79	6184	0060	RAU	1109	79	6184	0060
C0061	79	6279	1012	RBR	1110	79	6279	1012
C0062	79	6364	0070	RCD	1111	79	6364	0070

C0063	79	6391	0072	RC1	1112	79	6391	0072
C0064	79	6392	0075	RC2	1113	79	6392	0075
C0065	79	6393	0078	RC3	1114	79	6393	0078
C0066	79	6482	0086	RDS	1115	79	6482	0086
C0067	79	6491	0070	RD1	1116	79	6491	0070
C0068	79	6492	0073	RD2	1117	79	6492	0073
C0069	79	6493	0076	RD3	1118	79	6493	0076
C0070	79	6567	1004	REG	1119	79	6567	1004
C0071	79	6573	1010	REL	1120	79	6573	1010
C0072	79	6578	1011	REQ	1121	79	6578	1011
C0073	79	7788	0079	RPY	1122	79	7788	0079
C0074	79	8261	0081	RSA	1123	79	8261	0081
C0075	79	8262	0083	RSB	1124	79	8262	0083
C0076	79	8263	0089	RSC	1125	79	8263	0089
C0077	79	8273	0066	RSL	1126	79	8273	0066
C0078	79	8274	0068	RSM	1127	79	8274	0068
C0079	79	8284	0061	RSU	1128	79	8284	0061
C0080	79	8361	0005	RTA	1129	79	8361	0005
C0081	79	8363	0003	RTC	1130	79	8363	0003
C0082	79	8375	0004	RTN	1131	79	8375	0004
C0083	79	8664	0055	RWD	1132	79	8664	0055
C0084	82	6383	0036	SCT	1133	82	6383	0036
C0085	82	6461	0022	SDA	1134	82	6461	0022
C0086	82	6482	0085	SDS	1135	82	6482	0085
C0087	82	6583	0027	SET	1136	82	6583	0027
C0088	82	6961	0023	SIA	1137	82	6961	0023
C0089	82	6962	0028	SIB	1138	82	6962	0028
C0090	82	7376	0016	SLO	1139	82	7376	0016
C0091	82	7383	0035	SLT	1140	82	7383	0035
C0092	82	7473	0018	SML	1141	82	7473	0018
C0093	82	7964	0031	SRD	1142	82	7964	0031
C0094	82	7983	0030	SRT	1143	82	7983	0030
C0095	82	8364	0024	STD	1144	82	8364	0024
C0096	82	8369	0029	STI	1145	82	8369	0029
C0097	82	8373	0020	STL	1146	82	8373	0020
C0098	82	8384	0021	STU	1147	82	8384	0021
C0101	82	8477	0011	SUP	1150	82	8477	0011
C0102	82	8761	0051	SXA	1151	82	8761	0051
C0103	82	8762	0053	SXB	1152	82	8762	0053
C0104	82	8763	0059	SXC	1153	82	8763	0059
C0105	82	8875	1006	SYN	1154	82	8875	1006
C0106	83	7384	0084	TLU	1155	83	7384	0084
C0107	84	6661	0002	UFA	1156	84	6661	0002
C0108	86	6482	0087	WDS	1157	86	6482	0087
C0109	86	7991	0071	WR1	1158	86	7991	0071
C0110	86	7992	0074	WR2	1159	86	7992	0074
C0111	86	7993	0077	WR3	1160	86	7993	0077
C0112	86	8361	0007	WTA	1161	86	8361	0007
C0113	86	8374	0056	WTM	1162	86	8374	0056
C0114	86	8375	0006	WTN	1163	86	8375	0006
C0115	99	9999	0001	TABLE END	1164	99	9999	0001

SUB 1 STORE K IN FWA TO LWA

```
        HED   1
SUBR1   STD   EXITX                STORE EXIT   1600  24  1196  1199
        STU   XXXX1                STORE K      1199  21  1961  1364
        LDD   FWA                  SET          1364  69  1217  1170
        SDA   FWA                  FWA          1170  22  1217  1220
        SLT    0004                LWA          1220  35  0004  1181
        SDA   XXXX2                ADDRESSES    1181  22  1962  1515
        RAU   FWA                                1515  60  1217  1421
        ALO   XXXX1    8003                      1421  15  1961  8003
 8003   STL    9999   NEXT         STORE K      8003  20  9999  1402
NEXT    SUP   XXXX2                END OF       1402  11  1962  1267
        NZU           EXITX        LOOP TEST    1267  44  1471  1196
        AUP    8001                             1471  10  8001  1379
        AUP   1DXXX    8003         STEP         1379  10  1020  8003

FWA     STL    9998   NEXT         CONSTANTS    1217  20  9998  1402
XXXX2    01    0000   XXXX2        ERASEABLE    1962  01  0000  1962
        HED
```

SUB 2 RESERVE UNRESERVE

```
        HED   2
SUB2R   STD   EXITY                RESERVE      1503  24  1813  1316
        LDD   Z        RU          ENTRY        1316  69  1769  1472
SUB2U   STD   EXITY                UNRESERVE    1603  24  1813  1366
        LDD   1I       RU          ENTRY        1366  69  1565  1472
RU      STD   W                    SET W        1472  24  1246  1299
        STL   N                    STORE N      1299  20  1653  1556
        SLO    8001                CALC AO      1556  16  8001  1913
        AUP    8003                AND PO       1913  10  8003  1571
        SRT    0003                             1571  30  0003  1479
        STU   X                                  1479  21  1284  1287
        SUP    8001                             1287  11  8001  1245
        SLT    0001                             1245  35  0001  1451
        STU   P                                  1451  21  1606  1609
        SUP    8001                             1609  11  8001  1367
        SLT    0002                             1367  35  0002  1473
        AUP    8003                             1473  10  8003  1281
        AUP   X                                  1281  10  1284  1239
        ALO   P                                  1239  15  1606  1711
        SLT    0004                             1711  35  0004  1621
        ALO   C1                                 1621  15  1506  1761
        STL   B0002                              1761  20  0901  1554
        LDD   C2                                 1554  69  1188  1291
        SDA   SPR                                1291  22  1231  1334
        AUP   C3       SU                        1334  10  1337  1423
SU      STU   SA                                 1423  21  1401  1604
        AUP   C4        8003                     1604  10  1558  8003
 8003   RAL    9992   B0002                     8003  65  9992  0901
B0002   SLT    0009   XX                        0901  35  0009  1521
XX      STU   UH                                 1521  21  1176  1429
        SLT    0001                             1429  35  0001  1185
        RAL    8002                             1185  65  8002  1293
```

```
         AUP   W                                1293  10  1246  1351
         SRT    0001                            1351  30  0001  1907
         AUP   UH       SPR                     1907  10  1176  1231
SPR      SRT    0009    SA                      1231  30  0009  1401
SA       STL    9983    B0001                   1401  20  9983  0900
B0001    RAL   N                  IS N ZERO     0900  65  1653  1308
         NZE              EXITY                1308  45  1362  1813
         SLO   1I                 REDUCE N      1362  16  1565  1669
         STL   N                  BY 1          1669  20  1653  1456
         RAU   SA                 IS AI         1456  60  1401  1705
         SUP   A197               IN LAST       1705  11  1358  1863
         BMI              TP      BLOCK OF      1863  46  1266  1317
         AUP   A201       SU      4             1266  10  1719  1423

TP       RAL   SPR                IS P 9        1317  65  1231  1235
         SLO   C2                               1235  16  1188  1343
         NZE              ZP                   1343  45  1296  1297
         ALO   C5                 STEP P        1296  15  1249  1703
         LDD   C1                               1703  69  1506  1509
         SDA   B0002                            1509  22  0901  1454
         STL   SPR                              1454  20  1231  1184
         RAU   SA                 REDUCE AI     1184  60  1401  1755
         SUP   C6         SU      BY 196        1755  11  1408  1423

ZP       LDD   C1                 SET P         1297  69  1506  1559
         STD   B0002              TO ZERO       1559  24  0901  1504
         LDD   C7                               1504  69  1458  1661
         STD   SPR                              1661  24  1231  1234
         RAU   SA                 REDUCE AI     1234  60  1401  1805
         SUP   C8         SU      BY 195        1805  11  1508  1423

C1       SLT    0000      XX      CONSTANTS     1506  35  0000  1521
C2       SRT    0009      SA                    1188  30  0009  1401
C3       STL   A0001      B0001                 1337  20  0600  0900
C4        45    0000       0001                1558  45  0000  0001
1I        00    0000       0001                1565  00  0000  0001
A197     STL   A0197      B0001                 1358  20  0796  0900
A201     STL   A0201      B0001                 1719  20  0800  0900
C5       SRT    0010      SA                    1249  30  0010  1401
C6        00    0196       0000                1408  00  0196  0000
C7       SRT    0000      SA                    1458  30  0000  1401
C8        00    0195       0000                1508  00  0195  0000
Z         00    0000       0000                1769  00  0000  0000
W         01    0000      W       ERASEABLE     1246  01  0000  1246
N         01    0000      N                     1653  01  0000  1653
B0002     01    0000      B0002                 0901  01  0000  0901
SPR       01    0000      SPR                   1231  01  0000  1231
SA        01    0000      SA                    1401  01  0000  1401
UH        01    0000      UH                    1176  01  0000  1176
X         01    0000      X                     1284  01  0000  1284
         HED

              SUB 3 PROCESS OP CODE

         HED   3
```

```
SUBR3    STD    EXITX                 STORE EXIT    0996    24    1196    1349
         RAL     1954                               1349    65    1954    1659
         SRT     0004                 IS OP         1659    30    0004    1819
         NZE             ILLOP        BLANK         1819    45    1522    1013
         SLT     0006                 IS OP         1522    35    0006    1387
         NZU             NUM          NUMERIC       1387    44    1341    1192
         SRT     0002                               1341    30    0002    1347
         STL    XXXX1                 SEARCH        1347    20    1961    1414
         SLO     8001                 SYMBOLIC      1414    16    8001    1671
         TLU    C0001                 OP TABLE      1671    84    1050    1855
         ALO    1        8002                      1855    15    1608    8002
 8002    RAL     9997    NEXT         IS            8002    65    9997    1501
NEXT     SLO    XXXX1                 SYM OP        1501    16    1961    1615
         SLT     0006                 LEGAL         1615    35    0006    1529
         NZU    ILLOP                               1529    44    1013    1384
         SLT     0001                 TEST FOR      1384    35    0001    1391
         NZU    PSEU                  PSEUDO OP     1391    44    1295    1346
         SLT     0001    SNO          STORE NUM     1346    35    0001    1753
SNO      STL    P0007                 650 OP        1753    20    1983    1236
         SRT     0004                 GET OPTIM     1236    30    0004    1397
         ALO    3        8002         CONSTANTS     1397    15    1650    8002
 8002    LDD     9996    NEX                        8002    69    9996    1399
NEX      STD    OPTIM    EXITX                      1399    24    1452    1196

NUM      SLO    4                     FORM          1192    16    1345    1449
         SLT     0002                 NUMERIC       1449    35    0002    1905
         SLO     8002                 OP            1905    16    8002    1963
         SRT     0001                 CODE          1963    30    0001    1869
         ALO     8001    SNO                        1869    15    8001    1753

ILLOP    RAL    P0010                 ILLEGAL OP    1013    65    1986    1441
         ALO    5                     SET 8         1441    15    1194    1499
         STL    P0010                 FOR BLANK     1499    20    1986    1289
         LDD    6        NEX          OP            1289    69    1242    1399

PSEU     SLT     0003                 PSEUDO        1295    35    0003    1803
         ALO    EXITX                 OP            1803    15    1196    1551
         ALO    1IXXX     8002                       1551    15    0992    8002

1        RAL     0000    NEXT         CONSTANTS     1608    65    0000    1501
2         10     0000     0000                      1700    10    0000    0000
3        LDD    N0001    NEX                        1650    69    0800    1399
4         90     9000     0000                      1345    90    9000    0000
5         00     0000     0008                      1194    00    0000    0008
6         55     0505     0999                      1242    55    0505    0999
         HED

                SUB 4 WHAT IS ADDRESS

         HED    4
SUBR4    STD    EXITZ                 STORE EXIT    1213    24    1416    1919
         STU    XXXX1                 STORE ADDR    1919    21    1961    1464
         SRT     0008                 IS C5         1464    30    0008    1333
         NZU             EXITZ        BLANK         1333    44    1437    1416
         STU    XXXX2                 SAVE C5       1437    21    1962    1665
```

```
         RAU    8002                ARE LOW 4      1665    60  8002  1523
         AUP    90XXX               CHARACTERS     1523    10  1178  1383
         BOV    LOOP     LOOP       NUMERIC        1383    47  1286  1286
LOOP     AUP    H1                                 1286    10  1339  1393
         BOV             SYM                       1393    47  1396  0998
         SLT    0002                               1396    35  0002  1853
         NZU    LOOP                               1853    44  1286  1658
         RAL    XXXX2               LOW 4 NUM      1658    65  1962  1417
         SLO    90XXX               IS C5          1417    16  1178  1433
         BMI             SYM        ALPHABETIC     1433    46  1336  0998
         ALO    29XXX                              1336    15  1189  1443
         BMI    SYM                                1443    46  0998  1447
         RAL    1IXXX               REGIONAL       1447    65  0992  1497
         AUP    XXXX1    AEX                       1497    10  1961  1715
AEX      ALO    EXITZ                              1715    15  1416  1721
         SLO    8002     8001                      1721    16  8002  8001
SYM      RAU    XXXX1               HED SYMBOL     0998    60  1961  1765
         LDD             SUB15                     1765    69  1018  1663
         ALO    2IXXX               STEP EXIT      1018    15  1771  1425
         STU    HSYMB    AEX                       1425    21  1230  1715
H1        10    0000     0000                      1339    10  0000  0000
HSYMB     01    0000     HSYMB      ERASEABLE      1230    01  0000  1230
         HED
```

SUB 5 TEST ABSOLUTE ADDRESS

```
         HED    5
SUBR5    STD    EXITZ               STORE EXIT     1750    24  1416  1969
         STL    XXXX1               STORE A        1969    20  1961  1514
         SLT    0004                               1514    35  0004  1475
         SLO    8002                               1475    16  8002  1483
         TLU    R0001               TLU            1483    84  1200  1656
         ALO    GET      8002       RANGE          1656    15  1709  8002
 8002    RAU    9972     X          TABLE          8002    60  9972  1177
X        SLT    0006                               1177    35  0006  1491
         SRT    0006                               1491    30  0006  1706
         AUP    EXITZ                              1706    10  1416  1821
         ALO    XXXX1                              1821    15  1961  1815
         SUP    8003     8001                      1815    11  8003  8001
GET      RAU    0000     X                         1709    60  0000  1177
R0001     00    1999      0000      RANGE          1200    00  1999  0000
R0002     00    7999      0003      TABLE          1201    00  7999  0003
R0003     00    8003      0001                     1202    00  8003  0001
R0004     00    8004      0003                     1203    00  8004  0003
R0005     00    8007      0001                     1204    00  8007  0001
R0006     00    8999      0003                     1205    00  8999  0003
R0007     00    9059      0002                     1206    00  9059  0002
R0008     99    9999      0003                     1207    99  9999  0003
         HED
```

SUB 6 SYMBOL TEST ROUTINE

```
         HED    6
SUBR6    STD    EXITZ               STORE EXIT     1275    24  1416  1320
         STU    S                   STORE SYMB     1320    21  1601  1654
```

```
        LDD     SWOF
        STD     SW
        MPY     SC
        RAL      8002
        SLT      0003
        MPY     CF
        SRT      0001
        SLT      0004
        ALO     L1P1
        STL     LOP1
        SLO     1DXXX
        STL     LO      SLI
SLI     STL     LI       8001
 8001   RAL      9990   A
A       NZE             UND
        SLO     S
        NZE     SW      DEF
SW      RAL     LI      OFF
OFF     SLO     LMAX
        NZE             MAX
        ALO     LMP1    SLI
ON      SLO     LO
        NZE             SWSYM
        ALO     LOP1    SLI
MAX     LDD     SWON
        STD     SW
        RAL     L1      SLI

UND     RAL     EXITZ
        ALO     1IXXX
        STL     EXITZ
        RAL     LI
        SLO     L1
        STL     LSYMB   ASU

DEF     RAL     LI
        LDD     ASU     SUBR8
ASU     AUP     S       EXITZ

SWSYM   HLT      0111   SYMOF
SYMOF   LDD     SYMON
        STD     SWSYM   SYMON
SYMON   RAL     EXITZ
        ALO     2IXXX    8002

SWOF    RAL     LI      OFF
SWON    RAL     LI      ON
SC       10      0100    1001
CF       00      0000    0004
L1      RAL      0000   A
L1P1    RAL      0001   A
LMAX    RAL     E0000   A
LMP1    RAL     E0001   A
S        01      0000   S
SW       01      0000   SW
```

```
SET SWITCH      1654    69    1758    1861
OFF             1861    24    1610    1764
SCRAMBLE        1764    19    1517    1238
SYMBOL          1238    65    8002    1547
GIVING          1547    35    0003    1806
LO              1806    19    1759    1330
                1330    30    0001    1587
SET             1587    35    0004    1597
TEST            1597    15    1850    1856
WORD            1856    20    1865    1168
                1168    16    1020    1525
SAVE LO         1525    20    1903    1487
INIT LI         1487    20    1614    8001
IS CONT OF      8001    65    9990    1395
LI ZERO         1395    45    1098    1549
IS CONT OF      1098    16    1601    1756
LI SYMB         1756    45    1610    1811
IS LI           1610    65    1614    1270
MAXIMUM         1270    16    1573    1227
                1227    45    1280    1331
STEP LI         1280    15    1533    1487
IS LI EQUA      1800    16    1903    1708
TO LO           1708    45    1412    1664
STEP LI         1412    15    1865    1487
SET             1331    69    1434    1537
SWITCH ON       1537    24    1610    1714
ZERO LI         1714    65    1467    1487

UNDEFINED       1549    65    1416    1871
STEP            1871    15    0992    1647
EXIT            1647    20    1416    1370
                1370    65    1614    1420
                1420    16    1467    1921
                1921    20    1575    1278

DEFINED         1811    65    1614    1470
GET             1470    69    1278    1381
EQUIVALENT      1278    10    1601    1416

S TAB FULL      1664    01    0111    1218
SET SW SYM      1218    69    1971    1224
ON              1224    24    1664    1971
                1971    65    1416    1572
                1572    15    1771    8002

CONSTANTS       1758    65    1614    1270
                1434    65    1614    1800
                1517    10    0100    1001
                1759    00    0000    0004
                1467    65    0000    1395
                1850    65    0001    1395
                1573    65    0399    1395
                1533    65    0400    1395
ERASEABLE       1601    01    0000    1601
                1610    01    0000    1610
```

```
LO          01      0000    LO                              1903    01    0000    1903
LI          01      0000    LI                              1614    01    0000    1614
LSYMB       01      0000    LSYMB                           1575    01    0000    1575
            HED

                    SUB 7 STORE SYMBOL AND EQUIV

            HED     7
SUBR7       STD     EXITZ                   STORE EXIT      1279    24    1416    1520
            LDD     SS                                      1520    69    1623    1226
            SDA     XXXX2     8001          STORE           1226    22    1962    8001
 8001       STU      9988     A             SYMBOL          8001    21    9988    1541
A           SUP      8001                                    1541    11    8001    1599
            STL     XXXX1                   SAVE E          1599    20    1961    1814
            SRT      0004                                   1814    30    0004    1625
            DIV     2IXXX                   CALCULATE       1625    14    1771    1232
            SLT      0004                   LOCATION        1232    35    0004    1493
            ALO     C1                      OF              1493    15    1446    1651
            LDD     C2                      E               1651    69    1704    1808
            SDA     SEL                     AND             1808    22    1911    1864
            LDD     C3                      STORE           1864    69    1617    1620
            SDA     SER                                     1620    22    1673    1276
            STL     OBEE                                    1276    20    1431    1484
            SLO      8001                                   1484    16    8001    1591
            ALO     XXXX1     OBEE                          1591    15    1961    1431
OBEE        LDD      9986     B                             1431    69    9986    1389
B           NZU     SER                                     1389    44    1673    1244
            SLT      0004     SEL                          1244    35    0004    1911
SS          STU      9987     A             CONSTANTS       1623    21    9987    1541
C1          LDD     E0001     B                             1446    69    0400    1389
C2          SDA      9985     EXITZ                        1704    22    9985    1416
C3          SIA      9984     EXITZ                        1617    23    9984    1416
OBEE         01      0000     OBEE          ERASEABLE       1431    01    0000    1431
SEL          01      0000     SEL                           1911    01    0000    1911
SER          01      0000     SER                           1673    01    0000    1673
            HED

                    SUB 8 GIVEN SYM LOC GET EQUIV

            HED     8
SUBR8       STD     EXIT                    STORE EXIT      1381    24    1534    1637
            LDD      8003                                   1637    69    8003    1294
            SDA     LSYMB                   STORE L         1294    22    1575    1328
            RAL      8001                                   1328    65    8001    1285
            DIV     2DXXX                                   1285    14    1288    1148
            SLT      0004                                   1148    35    0004    1809
            ALO     E1         8002                         1809    15    1462    8002
 8002       LDD      9975     TR                            8002    69    9975    1378
TR          NZU              LH                            1378    44    1481    1282
            RAM      8001     LR           GET E RH         1481    67    8001    1439
LH          RAM      8001                  GET E LH         1282    67    8001    1489
            SRT      0004     LR                            1489    30    0004    1439
LR          LDD      8003                                   1439    69    8003    1496
            SIA     EQUIV                                   1496    23    1223    1326
            RAL     LSYMB     EXIT                          1326    65    1575    1534
```

```
E1          LDD   E0001   TR          CONSTANT      1462   69   0400   1378
EXIT         01    0000   EXIT        ERASEABLE     1534   01   0000   1534
EQUIV        01    0000   EQUIV                     1223   01   0000   1223
            HED

                  SUB 9  CALCULATE REG ADDRESS
            HED   9
SUBR9       STD   EXITZ               STORE EXIT    1174   24   1416   1670
            SRT    0008                             1670   30   0008   1539
            RAL    8003                             1539   65   8003   1697
            SLT    0004                             1697   35   0004   1858
            ALO   C        8002       IS            1858   15   1512   8002
 8002       RAL    9991   NEX         REGION        8002   65   9991   1445
NEX         BDO   ILL                 DEFINED       1445   90   1649   1701
            SLT    0001                             1701   35   0001   1908
            RAL    8002                             1908   65   8002   1667
            SRT    0001                             1667   30   0001   1723
            LDD   EXITZ                             1723   69   1416   1720
            BD6           L                         1720   96   1773   1675
            BD5   D       I                         1773   95   1376   1428
L           ALO    1957   ALL                       1675   15   1957   1562
D           ALO    1958   ALL                       1376   15   1958   1562
I           ALO    1959   ALL                       1428   15   1959   1562
ALL         SLO   1IXXX                            1562   16   0992   1747
            BMI   ILL     EXITZ                     1747   46   1649   1416
ILL         RAL   EXITZ               UNDEFINED     1649   65   1416   1622
            ALO   1IXXX    8002       OR ILLEG      1622   15   0992   8002

C           RAL    0960   NEX         CONSTANT      1512   65   0960   1445
            HED
                  SUB 10 SET CC 8 AND PUNCH

SUB10       ALO   P0010                             1405   15   1986   1641
            ALO   84TH                              1641   15   1344   1699
            STL   P0010                             1699   20   1986   1589
            PCH   P0001    8003                     1589   71   1977   8003

84TH         00    0800    0000       CONSTANT      1344   00   0800   0000

                  SUB 11 FIND AND RESERVE BEST

            HED   0
SUB11       LDD   DRUMT               TEST          1801   69   1212   1965
            BDO           SEX         DRUM TAG      1965   90   1770   1820
            STL   EXIT                IS ADR L      1770   20   1725   1478
            BD6   DI                                 1478   96   1531   1633
            RAL    8003   SSW         L             1633   65   8003   1741
DI          LDD   F                   D OR I        1531   69   1634   1787
            SDA   XXXX1   SUB13       FIND OPTIM    1787   22   1961   1964
GDA         SLT    0004               DYNAM ADR     1851   35   0004   1762
            ALO    8002                             1762   15   8002   1672
            ALO    8002   SSW                       1672   15   8002   1741
SSW         LDD   OFF                 SET SW OFF    1741   69   1444   1797
            STD   SW                                1797   24   1584   1837
```

```
                ALO     A1P1
                STL     BP1
                SLO     1DXXX
                STL     AO          SAI
SAI             STL     AI           8001
 8001           RAU      9975       TA
TA              NZU     YES         SW
SW              RAU     AI          SWOF
SWOF            SLO     AMAX
                NZE                 MAX
                ALO     AMP1        SAI
SWON            SLO     AO
                NZE                 FULL
                ALO     BP1         SAI
MAX             LDD     ON
                STD     SW
                RAL     A1          SAI

FULL            HLT      0222
                LDD     H9XXX
                STD     DRUMT
                RAL     EXIT        SEX
SEX             ALO     1IXXX        8002

YES             SCT      0000
                SLT      0001
                SRT      0001
                STL     XXXX2
                SUP      8003
                SLT      0004
                AUP      8001
                ALO     SRP          8002
 8002           SRT      0009       SCA
SCA             RAU      8003
                ALO     AI
                LDD     ST
                SDA     ERAS         8001
 8001           STU      9972       CA
CA              SUP      8001
                SLO     A1
                SRT      0004
                DIV     4I
                MPY     500
                ALO      8003
                SUP      8001
                AUP     XXXX2
                MPY     50
                ALO      8003
                SUP      8001       EXIT
F                00      0000       GDA
OFF             RAL     AI          SWOF
A1P1            RAU     A0002       TA
AMAX            RAU     A0200       TA
AMP1            RAU     A0201       TA
ON              RAL     AI          SWON
```

```
GET TABLE       1837    15  1290    1495
START ADDR      1495    20  1915    1268
                1268    16  1020    1775
SAVE AO         1775    20  1804    1612
                1612    20  1687    8001
IS A LOCAT      8001    60  9975    1579
AVAILABLE       1579    44  1583    1584
                1584    60  1687    1691
IS AI MAX       1691    16  1394    1749
                1749    45  1502    1754
STEP AI         1502    15  1906    1612
IS AI EQUA      1751    16  1804    1859
TO AO           1859    45  1662    1914
STEP AI         1662    15  1915    1612
SET SW ON       1754    69  1909    1712
                1712    24  1584    1737
SET AI TO       1737    65  1240    1612

DRUM PAKED      1914    01  0222    1318
SET DRUM        1318    69  1216    1870
TAG TO 9        1870    24  1212    1466
STEP EXIT       1466    65  1725    1820
                1820    15  0992    8002

RESERVE         1583    36  0000    1660
LOCATION        1660    35  0001    1717
FOUND           1717    30  0001    1823
SAVE P          1823    20  1962    1516
                1516    11  8003    1873
                1873    35  0004    1683
                1683    10  8001    1791
                1791    15  1494    8002
NULIFY SCT      8002    30  0009    1722
                1722    60  8003    1629
                1629    15  1687    1841
                1841    69  1544    1847
                1847    22  1901    8001
                8001    21  9972    1825
CALCULATE       1825    11  8001    1733
LOCATION        1733    16  1240    1545
FOUND           1545    30  0004    1710
                1710    14  1616    1426
                1426    19  1679    1552
                1552    15  8003    1760
                1760    11  8001    1767
                1767    10  1962    1817
                1817    19  1920    1340
                1340    15  8003    1897
                1897    11  8001    1725
CONSTANTS       1634    00  0000    1851
                1444    65  1687    1691
                1290    60  0601    1579
                1394    60  0799    1579
                1906    60  0800    1579
                1909    65  1687    1751
```

```
A1          RAU    A0001    TA                          1240    60    0600    1579
SRP         SRT     0000    SCA                         1494    30    0000    1722
ST          STU     9999    CA                          1544    21    9999    1825
4I           00     0000     0004                       1616    00    0000    0004
500          00     0000     0500                       1679    00    0000    0500
50           00     0000     0050                       1920    00    0000    0050
FON         RAL     8001    STEPX                       1602    65    8001    1810
AO           01     0000    AO          ERASEABLE       1804    01    0000    1804
AI           01     0000    AI                          1687    01    0000    1687
BP1          01     0000    BP1                         1915    01    0000    1915
EXIT         01     0000    EXIT                        1725    01    0000    1725
            HED

                 SUB 12 SET BLANK L 8

SUB12       ALO    P0010                               0991    15    1986    1891
            ALO    87TH                                1891    15    1594    1799
            STL    P0010     8003                      1799    20    1986    8003

87TH         00     0000     8000       CONSTANT        1594    00    0000    8000

                 SUB 13 CAL OPTIMUM DYNAMIC ADR

            HED    Y
SUB13       STD    EXITZ                 STORE EXIT    1964    24    1416    1970
            BD5             I            D OR I        1970    95    1923    1875
            RAL    OPTIM                 D             1923    65    1452    1860
            SLT     0001                               1860    35    0001    1867
            SLO     8002                               1867    16    8002    1925
            SLT     0001                               1925    35    0001    1581
            ALO     8001                               1581    15    8001    1639
            SRT     0003    SEO                        1639    30    0003    1947
I           RAL    OPTIM                 I             1875    65    1452    1910
            BD2    SHOP                  SHIFT TEST    1910    92    1666    1716
            BD3    XAS                   XAS TEST      1716    93    1772    1822
            SLT     0002    SEO                        1822    35    0002    1947
SEO         STL    XXXX1                 SAVE EV OD    1947    20    1961    1766
            RAL    OPREG                 IS BASE       1766    65    1872    1277
            DIV    2IXXX                 EVEN OR OD    1277    14    1771    1332
            RAU     8003                               1332    60    8003    1689
            ALO    XXXX1                              1689    15    1961    1816
            NZU             R8                         1816    44    1922    1972
            SLT     0002                               1922    35    0002    1729
            RAL     8002    R8                         1729    65    8002    1972
R8          SRT     0008                  GET BASE      1972    30    0008    1941
            ALO    OPREG                 PLUS DELTA    1941    15    1872    1327
            DIV    50                    MOD 50        1327    14    1380    1390
            RAL     8003    EXITZ                      1390    65    8003    1416

SHOP        RAL    P0007                 TLU UNITS     1666    65    1983    1887
            SRT     0004                 DIGIT OF      1887    30    0004    1997
            SLT     0009                 D ADDRESS     1997    35    0009    1917
            SLO     8002                               1917    16    8002    1975
            TLU    U0001                              1975    84    1250    1812
            ALO    GU        8002                     1812    15    1866    8002
```

```
 8002     RAL     9969     TOP                          8002  65  9969  1973
TOP       SLT     0002                                  1973  35  0002  1779
          LDD     OPTIM                IS OP SRD        1779  69  1452  1862
          BD3               SEO                        1862  93  1916  1947
          SLT     0004      SEO        SRD             1916  35  0004  1947

XAS       RAL     P0007                TLU             1772  65  1983  1937
          SRT      0004                D ADDRESS       1937  30  0004  1198
          SLT      0006                                1198  35  0006  1966
          SLO      8002                                1966  16  8002  1476
          TLU     I0001                                1476  84  1300  1912
          ALO     GXD       8002                      1912  15  1967  8002
 8002     RAL      9968     NXT                        8002  65  9968  1274
NXT       SLT      0004     SEO                        1274  35  0004  1947

U0001      00      2322      2524      SHIFT           1250  00  2322  2524
U0002      10      0706      0706      OPTIMIZING      1251  10  0706  0706
U0003      20      0706      0908      TABLE           1252  20  0706  0908
U0004      30      0908      1110                      1253  30  0908  1110
U0005      40      1110      1312                      1254  40  1110  1312
U0006      50      1312      1514                      1255  50  1312  1514
U0007      60      1514      1716                      1256  60  1514  1716
U0008      70      1716      1918                      1257  70  1716  1918
U0009      80      1918      2120                      1258  80  1918  2120
U0010      90      2120      2322                      1259  90  2120  2322

I0001      19      9906      0600      X ACCUM         1300  19  9906  0600
I0002      79      9907      0700      ADD SUB         1301  79  9907  0700
I0003      80      0008      0800      TABLE           1302  80  0008  0800
I0004      80      0106      0600                      1303  80  0106  0600
I0005      80      0209      0800                      1304  80  0209  0800
I0006      80      0308      0900                      1305  80  0308  0900
I0007      90      5908      0800                      1306  90  5908  0800
I0008      99      9909      0900                      1307  99  9909  0900

GU        RAL      0000     TOP       CONSTANTS       1866  65  0000  1973
GXD       RAL      0000     NXT                       1967  65  0000  1274
50         00      0000      0050                     1380  00  0000  0050
          HED
```

SUB 14 PUNCH AVAIL TABLE

```
          HED     P
SUB14     STD     EXITX                STORE EXIT      1403  24  1196  1849
          LDD     85TH                 SET PUNCH       1849  69  1652  1368
          STD     P0010                8               1368  24  1986  1739
          LDD     A1                   INIT AI         1739  69  1292  1595
          STD     XXXX1                                1595  24  1961  1418
          RAL     RS1       LOOP       INIT RS         1418  65  1324  1829
LOOP      AUP     C1         8001                      1829  10  1382  8001
 8001     STL      9999     NEXT       SET LOCAT       8001  20  9999  1702
NEXT      SUP     TW1                                  1702  11  1468  1374
          NZU               SRS                        1374  44  1377  1528
          AUP     C2                                   1377  10  1430  1335
          ALO     C3         8003                      1335  15  1338  8003
```

```
SRS     STL   XXXX2                  SAVE RS      1528  20  1962  1518
        RAU   C4                                  1518  60  1424  1879
        ALO   XXXX1    8002                       1879  15  1961  8002
 8002   LDD    9998    8003           STORE       8002  69  9998  8003
 8003   STD    9997   TP             AV TABLE     8003  24  9997  1752
TP      SUP   TW2                                 1752  11  1618  1474
        NZU           PUN                         1474  44  1427  1578
        AUP   C5                                  1427  10  1480  1385
        ALO   C6       8002                       1385  15  1388  8002
PUN     PCH   P0001                               1578  71  1977  1477
        SLO   AIM                  IS AI MAX      1477  16  1530  1435
        NZE           EXITX                       1435  45  1438  1196
        ALO   AMP1                 STEP AI        1438  15  1342  1248
        STL   XXXX1                               1248  20  1961  1668
        RAL   XXXX2                               1668  65  1962  1718
        SLO   C7      LOOP                        1718  16  1524  1829

C1      STL   P0001   NEXT         CONSTANTS      1382  20  1977  1702
C2      STL   P0009   NEXT                        1430  20  1985  1702
C3       00    0500    0500                       1338  00  0500  0500
C4      STD   P0002   TP                          1424  24  1978  1752
C5      STD   P0010   TP                          1480  24  1986  1752
C6       00    0001    0000                       1388  00  0001  0000
C7       00    1499    1499                       1524  00  1499  1499
TW1     STL   P0007   NEXT                        1468  20  1983  1702
TW2     STD   P0008   TP                          1618  24  1984  1752
85TH     00    0080    0000                       1652  00  0080  0000
A1      LDD   A0001    8003                       1292  69  0600  8003
RS1      00    0000    0450                       1324  00  0000  0450
AIM     LDD   A0200    8003                       1530  69  0799  8003
AMP1    LDD   A0201    8003                       1342  69  0800  8003
        HED
```

SUB 15 HEADING ROUTINE

```
        HED   H
SUB15   STD   EXITY                SAVE EXIT    1663  24  1813  1768
        LDD    8003                IS C1        1768  69  8003  1574
        SLT    0008                BLANK        1574  35  0008  1543
        NZU   DH                                  1543  44  1298  1348
        RAU    8001                HEAD         1348  60  8001  1818
        AUP   0000H   EXITY                      1818  10  1329  1813
DH      RAU    8001   EXITY        DONT HEAD    1298  60  8001  1813
        HED
```

SUB 16 INITIALIZATION

```
SUB16   STD   EXITY                STORE EXIT   1353  24  1813  1868
        RAL   I1                                  1868  65  1624  1929
        STU   P0009                ZERO CARD    1929  21  1985  1488
        STD   0000H                ZERO HEAD    1488  24  1329  1432
        LDD           SUBR1        ZERO SYM T   1432  69  1485  1600
        RAL   I2                   MAKE DRUM    1485  65  1538  1593
        AUP   I3                   AVAILABLE    1593  10  1546  1802
        LDD           SUBR1                     1802  69  1918  1600
```

```
         LDD   H8XXX                SET DRUM      1918   69  1406  1968
         STD   DRUMT                TAG TO 8      1968   24  1212  1674
         LDD   I4                   SET SWSYM     1674   69  1527  1580
         STD   SWSYM                OFF           1580   24  1664  1724
         RAL   I5                   UNDEFINE      1724   65  1577  1631
         AUP   H8XXX                REGIONS       1631   10  1406  1774
         LDD   EXITY   SUBR1                      1774   69  1813  1600

I1       00    S0001   E0200       CONSTANTS     1624   00  0000  0599
I2       00    A0001   A0200                     1538   00  0600  0799
I3       11     1111    1111                     1546   11  1111  1111
I4       01     0111   SYMOF                     1527   01  0111  1218
I5       00     1021    1049                     1577   00  1021  1049
PACOF    BD6   FINDI   FINDL                     1852   96  1824  1874
```

SUB 17 CALC 800X EQUIVALENT

```
         HED   X
SB17D    LDD   DEQ     DI          D EQUIV       1902   69  1924  1627
SB17I    LDD   IEQ     DI          I EQUIV       1854   69  1974  1627
DI       STD   XXXX1                SAVE TAG      1627   24  1961  1526
         STU   EXITY                STORE EXIT    1526   21  1813  1576
         STL   XXXX2                STORE 800X    1576   20  1962  1626
         LDD   XXXX1   SUB13        GET OPTIM     1626   69  1961  1964
SDA      STL   XXXX1                DYNAM ADDR    1904   20  1961  1676
         DIV   2IXXX                IS DY ADDR    1676   14  1771  1482
         NZU   OD      EV           EVEN OR OD    1482   44  1535  1386
OD       RAL   8002    EO                         1535-  65  1588  1643
EV       RAL   8003    EO                         1386   65  1789  1643
EO       SLO   XXXX2                              1643   16  1962  1726
         NZE           ADD1                       1726   45  1630  1681
         RAL   XXXX1   EXITY                     1630   65  1961  1813
ADD1     RAL   XXXX1                              1681   65  1961  1776
         ALO   1IXXX   EXITY                     1776.  15  0992  1813

DEQ      00     0008   SDA         CONSTANTS     1924   00  0008  1904
IEQ      00     0009   SDA                       1974   00  0009  1904
8002     00     0000    8002                     1588   00  0000  8002
8003     00     0000    8003                     1789   00  0000  8003
         HED
```

SUB 18 INDEX ADDRESS

```
         HED   W
INDEX    STD   EXITY                STORE EXIT    1826   24  1813  1876
         STL   XXXX1                STORE ADDR    1876   20  1961  1926
         RAU    1954                              1926   60  1954  1976
         SLT    0007                              1976   35  0007  1693
         LDD   EXITY                              1693   69  1813  1677
         BD5   D                    D OR I        1677   95  1680  1532
         SLT    0002   D                         1532   35  0002  1680
D        SRT    0009                              1680   30  0009  1727
         MPY   2000I                              1727   19  1014  1684
         LDD   EXITY                              1684   69  1813  1777
         BD6   DS                   DRUM 0 COR    1777   96  1730  1582
```

```
         SRT    0001    DS        CORE          1582    30   0001   1730
DS       ALO    XXXX1   EXITY                   1730    15   1961   1813

EXITY     01    0000    EXITY     ERASEABLE     1813    01   0000   1813
         HED

                SUB 19 PROCESS LOCATION

         REG    D0923     0923    PROC L
         REG    G0925     0925
         REG    J0928     0928
         REG    K0931     0931
         REG    L0933     0933

         HED    A
PROCL    STD    EXITX             STORE EXIT    0969    24   1196   1899
         RAU     1951             IS L BLANK    1899    60   1951   1827
         NZU    NB                             1827    44   1731   1632
         LDD    DRUMT             BLANK TEST    1632    69   1212   1877
         BDO    B       D0002     DRUM TAG      1877    90   1781   0924
B        RAL    OPREG   SETL      BLANK         1781    65   1872   1927
SETL     SLT     0004             SET L         1927    35   0004   1987
         LDD    P0008             TO OR         1987    69   1984   1638
         SDA    P0008   EXITX                   1638    22   1984   1196
NB       LDD    G       SUBR4     WHAT IS L     1731    69   1734   1213
G0001    RAL     1957   K0001     ABSOLUTE      0925    65   1957   0931
G0002    LDD    K       SUBR9     REGIONAL      0926    69   1780   1174
G0003    LDD    J       SUBR6     SYMBOLIC      0927    69   1830   1275
K0001    LDD    L       SUBR5     TEST RANGE    0931    69   1784   1750
K0002    RAU    87TH    X         REG ERROR     0932    60   1585   1839
X        AUP    P0010             SET BLANK     1839    10   1986   1392
         STU    P0010   SETL      L8            1392    21   1986   1927
L0001    STL    OPREG   SETL      DRUM ADDR     0933    20   1872   1927
L0002    AUP    86TH    800X      800X          0934    10   1688   1743
L0003    LDD    ORCEQ   89X       CORE ADDR     0935    69   1738   1442
L0004    RAU    87TH    X         OTHER         0936    60   1585   1839
800X     LDD    ORXEQ   89X                     1743    69   1596   1442
89X      STD    OPREG   X                       1442    24   1872   1839
J0001    RAL    EQUIV   K0001     SYM DEFIND    0928    65   1223   0931
J0002    RAL    D       SUB11     SYM UNDEF     0929    65   1682   1801
J0003    RAU    87TH    X         S TAB FULL    0930    60   1585   1839
D0001    STL    OPREG   SS        S EQ FOUND    0923    20   1872   1628
D0002    RAU    87TH    X         DRUM PAKED    0924    60   1585   1839
SS       AUP    HSYMB             STORE         1628    10   1230   1635
         ALO    LSYMB             SYMBOL        1635    15   1575   1880
         LDD    B       SUBR7                   1880    69   1781   1279

G         00    0000    G0001     CONSTANTS     1734    00   0000   0925
K         00    0090    K0001                   1780    00   0090   0931
J         00    0000    J0001                   1830    00   0000   0928
L         00    0000    L0001                   1784    00   0000   0933
D         00    0090    D0001                   1682    00   0090   0923
86TH      00    0008     0000                   1688    00   0008   0000
87TH      00    0000     8000                   1585    00   0000   8000
EXITX     01    0000    EXITX     ERASEABLE     1196    01   0000   1196
```

```
          HED

                SUB 20 PROCESS DATA ADDRESS

          REG   D0937    0937        PROC D
          REG   F0939    0939
          REG   G0941    0941
          REG   J0944    0944
          REG   K0946    0946
          REG   L0949    0949

          HED   B
PROCD     STD   EXITX                STORE EXIT      0972   24   1196   1949
          RAU    1952                IS D BLANK      1949   60   1952   1678
          NZU   NB                                   1678   44   1831   1732
          RAL   D         SUB11      FIND            1732   65   1685   1801
D0001     STL   ORBAL     L0004      OPTIMUM D       0937   20   1492   0952
D0002     RAU   88TH      X          DRUM PAKED      0938   60   1542   1398
BT        LDD   OPTIM                IS OP           1728   69   1452   1778
          BD1   EXITX                A BRANCH        1778   91   1196   1783
          STL   OPREG     EXITX      D TO OR         1783   20   1872   1196
X         AUP   P0010                SET BLANK       1398   10   1986   1592
          STU   P0010     EXITX                      1592   21   1986   1196
NB        LDD   G         SUBR4      WHAT IS D       1831   69   1834   1213
G0001     RAL    1958     J0001      ABSOLUTE        0941   65   1958   0944
G0002     LDD   J         SUBR9      REGIONAL        0942   69   1645   1174
G0003     LDD   K         SUBR6      SYMBOLIC        0943   69   1646   1275
J0001     LDD   L         SUBR5      TEST RANGE      0944   69   1448   1750
J0002     RAU   88TH      X          REG ERROR       0945   60   1542   1398
L0001     LDD   AXD       INDEX      DRUM ADDR       0949   69   1828   1826
L0002     SLT    0004     800X       800X            0950   35   0004   1878
L0003     LDD   AXC       INDEX      CORE ADDR       0951   69   1928   1826
L0004     SLT    0004     SD         OTHER           0952   35   0004   1930
800X      LDD   P0007                SET 800X D      1878   69   1983   1436
          SDA   P0007                                1436   22   1983   1486
          SRT    0004                                1486   30   0004   1498
          AUP   XEQ       SB17D      GET 800X E      1498   10   1881   1902
SCD       SLT    0004                SET CORE D      1931   35   0004   1642
          LDD   P0007                                1642   69   1983   1536
          SDA   P0007                                1536   22   1983   1586
          SRT    0004                                1586   30   0004   1548
          LDD   CEQ       SUB13      GET CORE E      1548   69   1782   1964
SCEQ      STL   ORCEQ     BT         SAVE CORE       1832   20   1738   1728
K0001     RAL   EQUIV     J0001      SYM DEFIND      0946   65   1223   0944
K0002     RAL   F         SUB11      SYM UNDEF       0947   65   1882   1801
K0003     RAU   88TH      X          S TAB FULL      0948   60   1542   1398
F0001     STL   EQ        SS         SAVE EQ         0939   20   1793   1696
F0002     RAU   88TH      X          DRUM PAKED      0940   60   1542   1398
SS        AUP   HSYMB                STORE           1696   10   1230   1735
          ALO   LSYMB                SYMBOL          1735   15   1575   1932
          LDD                SUBR7                   1932   69   1785   1279
          RAL   EQ          L0004                    1785   65   1793   0952
SD        LDD   P0007                SET D ADDR      1930   69   1983   1636
          SDA   P0007                                1636   22   1983   1686
          SRT    0004     BT                         1686   30   0004   1728
```

```
D          00     0088   D0001      CONSTANTS    1685   00   0088   0937
G          00     0000   G0001                   1834   00   0000   0941
J          00     0088   J0001                   1645   00   0088   0944
L          00     0000   L0001                   1448   00   0000   0949
F          00     0088   F0001                   1882   00   0088   0939
K          00     0000   K0001                   1646   00   0000   0946
AXD        00     0088   D0001                   1828   00   0088   0937
AXC        00     0098   SCD                     1928   00   0098   1931
XEQ       STL    ORXEQ   BT                      1881   20   1596   1728
CEQ        00     0008   SCEQ                    1782   00   0008   1832
88TH       00     0000    0800                   1542   00   0000   0800
EQ         01     0000   EQ           ERASEABLE  1793   01   0000   1793
          HED

                SUB 21 PROCESS INSTR ADDRESS

          REG   D0953     0953       PROC I
          REG   F0955     0955
          REG   G0958     0958
          REG   J0960     0960
          REG   K0962     0962
          REG   L0965     0965

          HED   C
PROCI     STD   EXITX                STORE EXIT   1453   24   1196   1833
          RAU    1953                IS I BLANK   1833   60   1953   1883
          NZU   NB                                1883   44   1788   1838
          RAU    1952                IS D BLANK   1838   60   1952   1933
          NZU   DNB                               1933   44   1888   1938
          LDD   DRUMT                D I BLANK    1938   69   1212   1884
          BDO             G0002      TEST DRUM    1884   90   1988   0959
          RAL   ORBAL     L0004      TAG          1988   65   1492   0968
DNB       RAL   D         SUB11      FIND BEST    1888   65   1692   1801
D0001     STL   ORBAL     L0004      FOUND        0953   20   1492   0968
D0002     RAL   P0010     X          DRUM PAKED   0954   65   1986   1742
X         ALO   89TH                              1742   15   1695   1934
          STL   P0010     EXITX                   1934   20   1986   1196
NB        LDD   F         SUBR4      WHAT IS I    1788   69   1792   1213
F0001     RAL    1959     J0001      ABSOLUTE     0955   65   1959   0960
F0002     LDD   J         SUBR9      REGIONAL     0956   69   1835   1174
F0003     LDD   K         SUBR6      SYMBOLIC     0957   69   1885   1275
J0001     LDD   L         SUBR5      TEST RANGE   0960   69   1935   1750
J0002     RAL   P0010     X          REG ERROR    0961   65   1986   1742
L0001     LDD   AXD       INDEX      DRUM ADDR    0965   69   1736   1826
L0002     LDD   P0007     800X       800X         0966   69   1983   1786
L0003     LDD   AXC       INDEX      CORE ADDR    0967   69   1836   1826
L0004     LDD   P0007                OTHER        0968   69   1983   1886
          SIA   P0007     MOR                     1886   23   1983   1936
800X      SIA   P0007                              1786   23   1983   1889
          AUP   XEQ       SB17I      GET 800X E   1889   10   1842   1854
90XX      LDD   P0007                SET CORE     1939   69   1983   1989
          SIA   P0007                ADDRESS      1989   23   1983   1440
          LDD   CEQ       SUB13      GET CORE E   1440   69   1843   1964
K0001     RAL   EQUIV     J0001      SYM DEFIND   0962   65   1223   0960
```

```
K0002    RAL    G        SUB11     SYM UNDEF    0963   65   1490   1801
K0003    RAL    P0010    X         S TAB FULL   0964   65   1986   1742
G0001    LDD    P0007    SI        FOUND BEST   0958   69   1983   1540
G0002    RAL    P0010    X         DRUM PAKED   0959   65   1986   1742
SI       SIA    P0007                           1540   23   1983   1590
         AUP    HSYMB              STORE        1590   10   1230   1640
         ALO    LSYMB              SYMBOL       1640   15   1575   1690
         LDD    MOR      SUBR7                 1690   69   1936   1279
MOR      LDD    ORBAL              SET OR       1936   69   1492   1745
         STD    OPREG    EXITX     TO ORB       1745   24   1872   1196
SCEQ     STL    ORCEQ    MOR       SAVE CORE    1740   20   1738   1936

D          00     0089   D0001     CONSTANTS    1692   00   0089   0953
F          00     0000   F0001                  1792   00   0000   0955
J          00     0089   J0001                  1835   00   0089   0960
K          00     0000   K0001                  1885   00   0000   0962
L          00     0000   L0001                  1935   00   0000   0965
G          00     0089   G0001                  1490   00   0089   0958
89TH       00     0000    0080                  1695   00   0000   0080
AXD        00     0089   L0004                  1736   00   0089   0968
AXC        00     0099   90XX                   1836   00   0099   1939
XEQ      STL    ORXEQ    MOR                    1842   20   1596   1936
CEQ        00     0009   SCEQ                   1843   00   0009   1740
           HED

1IXXX      00     0000    0001     CONSTANTS    0992   00   0000   0001
1DXXX      00     0001    0000                  1020   00   0001   0000
2IXXX      00     0000    0002                  1771   00   0000   0002
2DXXX      00     0002    0000                  1288   00   0002   0000
H8XXX      80     0000    0000                  1406   80   0000   0000
H9XXX      90     0000    0000                  1216   90   0000   0000
90XXX      00     0000    0090                  1178   00   0000   0090
29XXX      00     0000    0029                  1189   00   0000   0029
2000I      00     0000    2000     CONSTANT     1014   00   0000   2000
TORG       00     0000   T0001                  0990   00   0000   1990

           PAT
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0000	0000000000	0450	0500	0000000000	0950	1000	0000000000	1450	1500	0000000000	1950
0001	0000000000	0451	0501	0000000000	0951	1001	0000000000	1451	1501	0000000000	1951
0002	0000000000	0452	0502	0000000000	0952	1002	0000000000	1452	1502	0000000000	1952
0003	0000000000	0453	0503	0000000000	0953	1003	0000000000	1453	1503	0000000000	1953
0004	0000000000	0454	0504	0000000000	0954	1004	0000000000	1454	1504	0000000000	1954
0005	0000000000	0455	0505	0000000000	0955	1005	0000000000	1455	1505	0000000000	1955
0006	0000000000	0456	0506	0000000000	0956	1006	0000000000	1456	1506	0000000000	1956
0007	0000000000	0457	0507	0000000000	0957	1007	0000000000	1457	1507	0000000000	1957
0008	0000000000	0458	0508	0000000000	0958	1008	0000000000	1458	1508	0000000000	1958
0009	0000000000	0459	0509	0000000000	0959	1009	0000000000	1459	1509	0000000000	1959
0010	0000000000	0460	0510	0000000000	0960	1010	0000000000	1460	1510	0000000000	1960
0011	0000000000	0461	0511	0000000000	0961	1011	0000000000	1461	1511	0000000000	1961
0012	0000000000	0462	0512	0000000000	0962	1012	0000000000	1462	1512	0000000000	1962
0013	0000000000	0463	0513	0000000000	0963	1013	0000000000	1463	1513	0000000000	1963
0014	0000000000	0464	0514	0000000000	0964	1014	0000000000	1464	1514	0000000000	1964
0015	0000000000	0465	0515	0000000000	0965	1015	0000000000	1465	1515	0000000000	1965
0016	0000000000	0466	0516	0000000000	0966	1016	0000000000	1466	1516	0000000000	1966
0017	0000000000	0467	0517	0000000000	0967	1017	0000000000	1467	1517	0000000000	1967
0018	0000000000	0468	0518	0000000000	0968	1018	0000000000	1468	1518	0000000000	1968
0019	0000000000	0469	0519	0000000000	0969	1019	0000000000	1469	1519	0000000000	1969
0020	0000000000	0470	0520	0000000000	0970	1020	0000000000	1470	1520	0000000000	1970
0021	0000000000	0471	0521	0000000000	0971	1021	0000000000	1471	1521	0000000000	1971
0022	0000000000	0472	0522	0000000000	0972	1022	0000000000	1472	1522	0000000000	1972
0023	0000000000	0473	0523	0000000000	0973	1023	0000000000	1473	1523	0000000000	1973
0024	0000000000	0474	0524	0000000000	0974	1024	0000000000	1474	1524	0000000000	1974
0025	0000000000	0475	0525	0000000000	0975	1025	0000000000	1475	1525	0000000000	1975
0026	0000000000	0476	0526	0000000000	0976	1026	0000000000	1476	1526	0000000000	1976
0027	0000000000	0477	0527	0000000000	0977	1027	0000000000	1477	1527	0000000000	1977
0028	0000000000	0478	0528	0000000000	0978	1028	0000000000	1478	1528	0000000000	1978
0029	0000000000	0479	0529	0000000000	0979	1029	0000000000	1479	1529	0000000000	1979
0030	0000000000	0480	0530	0000000000	0980	1030	0000000000	1480	1530	0000000000	1980
0031	0000000000	0481	0531	0000000000	0981	1031	0000000000	1481	1531	0000000000	1981
0032	0000000000	0482	0532	0000000000	0982	1032	0000000000	1482	1532	0000000000	1982
0033	0000000000	0483	0533	0000000000	0983	1033	0000000000	1483	1533	0000000000	1983
0034	0000000000	0484	0534	0000000000	0984	1034	0000000000	1484	1534	0000000000	1984
0035	0000000000	0485	0535	0000000000	0985	1035	0000000000	1485	1535	0000000000	1985
0036	0000000000	0486	0536	0000000000	0986	1036	0000000000	1486	1536	0000000000	1986
0037	0000000000	0487	0537	0000000000	0987	1037	0000000000	1487	1537	0000000000	1987
0038	0000000000	0488	0538	0000000000	0988	1038	0000000000	1488	1538	0000000000	1988
0039	0000000000	0489	0539	0000000000	0989	1039	0000000000	1489	1539	0000000000	1989
0040	0000000000	0490	0540	0000000000	0990	1040	0000000000	1490	1540	0000011110	1990
0041	0000000000	0491	0541	0000000000	0991	1041	0000000000	1491	1541	0000000000	1991
0042	0000000000	0492	0542	0000000000	0992	1042	0000000000	1492	1542	0000000110	1992
0043	0000000000	0493	0543	0000000000	0993	1043	0000000000	1493	1543	0000000111	1993
0044	0000000000	0494	0544	0000000000	0994	1044	0000000000	1494	1544	0011111111	1994
0045	0000000000	0495	0545	0000000000	0995	1045	0000000000	1495	1545	0000011111	1995
0046	0000000000	0496	0546	0000000000	0996	1046	0000000000	1496	1546	0000111111	1996
0047	0000000000	0497	0547	0000000000	0997	1047	0000000000	1497	1547	0000000000	1997
0048	0000000000	0498	0548	0000000000	0998	1048	0000000000	1498	1548	0111111110	1998
0049	0000000000	0499	0549	0000000000	0999	1049	0000000000	1499	1549	0000000000	1999

AVAILABILITY TABLE

Overpunch Y(12) in columns 2, 10, 20, ..., 80

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6I 1952 1953  69 1952 1951  24 1995 1954  69 1955 1956  69 1954 1953  24 1996 1957  69 1958 8000  69 1956 1955
2D 1997 1952  69 1953 1954  69 1958 1957  24 1998 1955  69 1957 1956  24 1999 1999  70 1995 0000
2D 0000 1996  70 0048 9999  24 0048 1997  65 0001 0030  24 0030 1998  69 0034 0039  24 0039 1999  22 0044 0047
2D 0047 1996  35 0004 0025  24 0025 1997  15 8001 0031  24 0031 1998  22 0036 0032  24 0032 1999  65 0035 0040
2D 0040 1996  10 0044 8002  24 0020 1997  10 0023 0027  24 0027 1998  15 8001 0033  24 0033 1999  11 0036 0041
2D 0041 1996  44 0045 0000  24 0045 1997  10 8001 8002  24 0034 1998  24 0000 0020  24 0035 1999  69 0002 8003
2D 0023 0000  00 0001 0000
00 0800 0007  00 0404 0998  00 0404 0998  33 2322 0999  00 0505 0998  00 0505 0998  00 0505 0998  00 0505 0998
00 0807 0007  00 0505 0998  33 1212 0999  33 0202 0999  33 0504 0999  33 0504 0999  99 9999 9999  99 9999 9999
00 0814 0007  33 1110 0999  33 0504 0999  33 0504 0999  33 0504 0999  33 0504 0999  33 2120 0999  54 0303 0999
00 0821 0007  45 0303 0999  34 0303 0999  34 0303 0999  33 0303 0999  44 0505 0998  00 0505 0998  00 0505 0998
00 0828 0007  33 1212 0999  33 0202 0999  00 0000 0988  00 0000 0888  33 2726 0999  33 2726 0999  33 0000 0999
00 0835 0007  00 0000 0988  00 0000 0988  33 2726 0999  33 2726 0999  33 0000 0999  33 0404 0998  33 0404 0998
00 0842 0007  33 0404 0998  33 0404 0998  34 0405 0998  43 0504 0998  33 0404 0998  33 0505 0998  33 0404 0998
00 0849 0007  33 0404 0998  00 0000 0898  00 0000 0898  00 0000 0898  00 0000 0898  44 0505 0998  00 0505 0998
00 0856 0007  00 0505 0998  00 0505 0998  00 0000 0898  00 0000 0898  33 0504 0999  33 0504 0999  99 9999 9999
00 0863 0007  99 9999 9999  33 1110 0999  33 0504 0999  33 0504 0999  33 0504 0999  33 0504 0999  33 0303 0999
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00 0877 0007  00 0000 0999  00 0000 0999  00 0505 0999  00 0000 0898  00 0000 0898  00 0000 0898  00 0000 0898
00 0884 0007  33 0506 0999  00 0606 0998  00 0606 0998  00 0606 0998  00 0000 0898  00 0000 0898  44 0505 0998
00 0891 0007  33 0505 0998  33 0505 0998  33 0505 0998  33 0505 0998  33 0505 0998  33 0505 0998  33 0505 0998
00 0898 0007  33 0505 0998  44 0505 0998  65 1653 1308  01 0000 0901  65 1958 1263  30 0008 1221  00 0000 0943
00 0905 0007  65 1959 1313  30 0008 1175  00 0000 0957  65 1951 1455  00 0000 1013  15 1519 1273  15 1519 1273
00 0912 0007  65 1986 1191  69 1016 0969  00 0000 8003  20 1519 1322  65 1986 1191  65 1959 0915  69 1371 1174
00 0919 0007  69 1372 1275  65 1223 0915  65 1986 1191  65 1986 1191  20 1872 1628  60 1585 1839  65 1957 0931
00 0926 0007  69 1780 1174  69 1830 1275  65 1223 0931  65 1682 1801  60 1585 1839  69 1784 1750  60 1585 1839
00 0933 0007  20 1872 1927  10 1688 1743  69 1738 1442  60 1585 1839  20 1492 0952  60 1542 1398  20 1793 1696
00 0940 0007  60 1542 1398  65 1958 0944  69 1645 1174  69 1646 1275  69 1448 1750  60 1542 1398  65 1223 0944
00 0947 0007  65 1882 1801  60 1542 1398  69 1828 1826  35 0004 1878  69 1928 1826  35 0004 1930  20 1492 0968
00 0954 0007  65 1986 1742  65 1959 0960  69 1835 1174  69 1885 1275  69 1983 1540  65 1986 1742  69 1935 1750
00 0961 0007  65 1986 1742  65 1223 0960  65 1490 1801  65 1986 1742  69 1736 1826  69 1983 1786  69 1836 1826
00 0968 0007  69 1983 1886  24 1196 1899  60 1519 1323  21 1984 0987  24 1196 1949  65 1957 1311  00 0000 1500
00 0975 0007  01 0000 0975  69 1262 1365  46 1180 1183  00 0000 1504  21 1961 1214  69 1952 1355  69 1953 1356
00 0982 0007  69 1954 1357  69 1955 1208  69 1956 1209  65 1985 0989  15 1189 1243  10 0990 0995  60 1960 1015
00 0989 0007  15 0992 0997  00 0000 1990  15 1986 1891  00 0000 0001  00 0000 0913  24 0600 1247  20 1986 8003
00 0996 0007  24 1196 1349  20 1985 0988  60 1961 1765  60 1952 1407  69 1950 1353  69 1404 1353  65 1959 1363
00 1003 0007  69 1406 1309  65 1952 1507  69 1406 1359  69 1216 1359  69 1460 0969  60 1511 1405  65 1952 1757
00 1010 0007  65 1952 1807  69 1406 1409  60 0975 1229  65 1986 1441  00 0000 2000  30 0002 0971  69 1019 0972
00 1017 0004  24 1979 1350  15 1771 1425  69 1350 1453  00 0001 0000
00 1050 0007  61 7366 1007  61 7376 0015  61 7473 0017  61 8477 0010  61 8761 0050  61 8762 0052  61 8763 0058
00 1057 0007  62 6476 0090  62 6491 0091  62 6492 0092  62 6493 0093  62 6494 0094  62 6495 0095  62 6496 0096
00 1064 0007  62 6497 0097  62 6498 0098  62 6499 0099  62 6975 0026  62 7361 1003  62 7379 1002  62 7461 0041
00 1071 0007  62 7462 0043  62 7463 0049  62 7469 0046  62 7677 1001  62 7685 0047  62 8283 0057  64 6985 0014
00 1078 0007  64 8579 0064  65 7884 1005  66 6164 0032  66 6174 0037  66 6485 0034  66 7477 0039  66 8262 0033
00 1085 0007  66 8274 0038  68 6564 1009  68 7383 0001  73 6464 0069  73 6469 0009  73 6962 0008  74 7788 0019
00 1092 0007  75 6566 0054  75 7677 0000  75 8382 0025  75 8961 0040  75 8962 0042  75 8963 0048  16 1601 1756
00 1099 0007  60 1953 1457  75 8965 0045  75 8984 0044  77 6183 1008  77 6368 0071  79 6161 0080  79 6162 0082
00 1106 0007  79 6163 0088  79 6173 0065  79 6174 0067  79 6184 0060  79 6279 1012  79 6364 0070  79 6391 0072
00 1113 0007  79 6392 0075  79 6393 0078  79 6482 0086  79 6491 0070  79 6492 0073  79 6493 0076  79 6567 1004
00 1120 0007  79 6573 1010  79 6578 1011  79 7788 0079  79 8261 0081  79 8262 0083  79 8263 0089  79 8273 0066
00 1127 0007  79 8274 0068  79 8284 0061  79 8361 0005  79 8363 0003  79 8375 0004  79 8664 0055  82 6383 0036
00 1134 0007  82 6461 0022  82 6482 0085  82 6583 0027  82 6961 0023  82 6962 0028  82 7376 0016  82 7383 0035
00 1141 0007  82 7473 0018  82 7964 0031  82 7983 0030  82 8364 0024  82 8369 0029  82 8373 0020  82 8384 0021
00 1148 0007  35 0004 1809  10 1352 8003  82 8477 0011  82 8761 0051  82 8762 0053  82 8763 0059  82 8875 1006
00 1155 0007  83 7384 0084  84 6661 0002  86 6482 0087  86 7991 0071  86 7992 0074  86 7993 0077  86 8361 0007
00 1162 0007  86 8374 0056  86 8375 0006  99 9999 0001  60 1957 1261  60 1957 1361  15 1020 8003  16 1020 1525
00 1169 0007  46 1172 0973  22 1217 1220  69 1984 1187  10 8001 0979  65 1957 1411  24 1416 1670  10 0978 8003
00 1176 0007  01 0000 1176  35 0006 1491  00 0000 0090  46 1182 1183  15 8001 1311  22 1962 1515  10 1014 0979
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SEVEN-WORDS PER CARD LISTING (1 of 3)

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00 1183 0007  60 1237 0991  60 1401 1755  65 8002 1293  65 1953 1707  22 1984 1237  30 0009 1401  00 0000 0029
00 1190 0007  69 1350 1553  15 1500 1505  16 1345 1449  24 1196 0999  00 0000 0008  00 0000 0908  01 0000 1196
00 1197 0007  35 0004 1557  35 0006 1966  21 1961 1364  00 1999 0000  00 7999 0003  00 8003 0001  00 8004 0003
00 1204 0007  00 8007 0001  00 8999 0003  00 9059 0002  99 9999 0003  24 1981 0984  24 1982 0985  00 0000 0902
00 1211 0007  44 1165 1166  01 1212 8000- 24 1416 1919  69 1450 1503  65 1959 1463  90 0000 0000  20 9998 1402
00 1218 0007  69 1971 1224  46 1222 1173  35 0004 1181  10 0974 8003  10 0975 1179  01 0000 1223  24 1664 1971
00 1225 0007  16 1178 1233  22 1962 8001  45 1280 1331  65 1953 1857  15 1959 1363  01 0000 1230  01 0000 1231
00 1232 0007  35 0004 1493  46 0986 1002  60 1401 1805  16 1188 1343  30 0004 1397  69 1190 1193  65 8002 1547
00 1239 0007  15 1606 1711  60 0600 1579  15 0994 1149  55 0505 0999  46 1002 1197  35 0004 1911  35 0001 1451
00 1246 0007  01 0000 1246  11 1550 1655  20 1961 1668  30 0010 1401  00 2322 2524  10 0706 0706  20 0706 0908
00 1253 0007  30 0908 1110  40 1110 1312  50 1312 1514  60 1514 1716  70 1716 1918  80 1918 2120  90 2120 2322
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00 1267 0007  44 1471 1196  16 1020 1775  16 1272 0977  16 1573 1227  69 1400 1503  00 0000 9060  69 0976 1279
00 1274 0007  35 0004 1947  24 1416 1320  20 1431 1484  14 1771 1332  10 1601 1416  24 1416 1520  15 1533 1487
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00 1316 0007  69 1769 1472  65 1231 1235  69 1216 1870  46 1564 1563  21 1601 1654  69 1400 1603  60 1952 1657
00 1323 0007  69 1400 1503  00 0000 0450  20 1329 1400  65 1575 1534  14 1380 1390  65 8001 1285  01 1329 8000-
00 1330 0007  30 0001 1587  69 1434 1537  60 8003 1689  44 1437 1416  10 1337 1423  15 1338 8003  15 1189 1443
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00 1344 0007  00 0800 0000  90 9000 0000  35 0001 1753  20 1961 1414  60 8001 1818  65 1954 1659  71 1977 1950
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00 1365 0007  90 1400 0970  69 1565 1472  35 0002 1473  24 1986 1739  15 1958 0944  65 1614 1420  00 0089 0915
00 1372 0007  00 0000 0920  15 1264 1619  44 1377 1528  15 8002 1283  15 1958 1562  10 1430 1335  44 1481 1282
00 1379 0007  10 1020 8003  00 0000 0050  24 1534 1637  20 1977 1702  47 1286 1286  35 0001 1391  15 1388 8002
00 1386 0007  65 1789 1643  44 1341 1192  00 0001 0000  44 1673 1244  65 8003 1416  44 1295 1346  21 1986 1927
00 1393 0007  47 1396 0998  60 0799 1579  45 1098 1549  35 0002 1853  15 1650 8002  10 1986 1592  24 1452 1196
00 1400 0007  60 1950 1405  01 0000 1401  11 1962 1267  24 1196 1849  60 1950 1405  15 1986 1641  80 0000 0000
00 1407 0007  69 1210 1213  00 0196 0000  24 1262 1415  69 1713 1275  15 1264 1269  15 1865 1487  10 8001 1271
00 1414 0007  16 8001 1671  65 1959 1763  01 1416 8000- 16 1178 1433  65 1324 1829  46 1568 1567  16 1467 1921
00 1421 0007  15 1961 8003  15 0975 1619  21 1401 1604  24 1978 1752  21 1230 1715  19 1679 1552  10 1480 1385
00 1428 0007  15 1959 1562  35 0001 1185  20 1985 1702  01 0000 1431  69 1485 1600  46 1336 0998  65 1614 1800
00 1435 0007  45 1438 1196  22 1983 1486  21 1962 1665  15 1342 1248  69 8003 1496  69 1843 1964  15 1194 1499
00 1442 0007  24 1872 1839  46 0998 1447  65 1687 1691  90 1649 1701  69 0400 1389  65 0992 1497  00 0000 0949
00 1449 0007  35 0002 1905  65 1961 1311  21 1606 1609  01 1452 8000- 24 1196 1833  20 1231 1184  35 0002 1211
00 1456 0007  60 1401 1705  69 1260 1213  30 0000 1401  10 1312 1167  69 1952 1555  69 1314 1017  69 0400 1378
00 1463 0007  16 1958 1513  30 0008 1333  35 0004 1375  65 1725 1820  65 0000 1395  20 1983 1702  15 1959 0960
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00 1477 0007  16 1530 1435  96 1531 1633  21 1284 1287  24 1986 1752  67 8001 1439  44 1535 1386  84 1200 1656
00 1484 0007  16 8001 1591  65 1538 1593  30 0004 1498  20 1614 8001  24 1329 1432  30 0004 1439  00 0089 0958
00 1491 0007  30 0006 1706  01 1492 8000- 15 1446 1651  30 0000 1722  20 1915 1268  23 1223 1326  10 1961 1715
00 1498 0007  10 1881 1902  20 1986 1289  00 8800 0000  16 1961 1615  15 1906 1612  24 1813 1316  69 1458 1661
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SEVEN-WORDS PER CARD LISTING (2 of 3)

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00 1638 0007  22 1984 1196  30 0003 1947  15 1575 1690  15 1344 1699  69 1983 1536  16 1962 1726  01 1644 8000-
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SEVEN-WORDS PER CARD LISTING (3 of 3)

INTERNATIONAL BUSINESS MACHINES CORPORATION, 590 MADISON AVE., NEW YORK 22, NEW YORK